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ABSTRACT

A project was undertaken to: (1) formulate objectives for a biology unit dealing with frog dissection and vertebrate anatomy, (2) on the basis of these objectives, develop self-instructional modules utilizing audio-visual and printed instructional materials, and (3) formulate instruments for the evaluation of the modules. The rationale for the project was based on the need to provide self-paced learning activities for students with poor reading ability, who are accustomed to visual instruction, or who have missed class and need to make up instruction. A review of the literature was used as a foundation for the research. Two instructional modules were developed; they included a printed packet, audio-visual presentations, video-cassettes, and pre- and post-tests. The project report outlines the procedures and methodology used in developing and evaluating the module objectives, producing the modules at the Learning Resources Center of the College of DuPage, developing instruments for evaluating the modules, conducting a classroom pilot test of the modules, and developing a teacher's guide. Results of the pilot test, based on a comparison of students' pre- and post-test scores are also presented, as well as the results of student and faculty evaluations of the modules. A bibliography and a description of the module components are appended. (JP)

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Development of Community College Instructional Modules for Biology and Comparative Vertebrate Anatomy

JURA B. VASILIAUSKAS

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A MAJOR APPLIED RESEARCH PROJECT
PRESENTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
OF THE DEGREE OF DOCTOR OF EDUCATION

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Abstract of a Major Applied Research Project Presented to Nova University in Partial Fulfillment of the Requirements for the Degree of Doctor of Education.

DEVELOPMENT OF COMMUNITY COLLEGE INSTRUCTIONAL MODULES FOR BIOLOGY AND COMPARATIVE VERTEBRATE ANATOMY

by

Jura B. Vasiliauskas

June, 1979

The Major Applied Research Project was based primarily on the following questions: What are the objectives of the frog dissection and anatomy unit? What strategy can be used to teach the unit of frog dissection and anatomy? How can teaching aids be developed and presented to help students with poor reading skills, slow or fast learning rates, or visual learning styles? What kind of study path could be offered to aid the student in making up work missed in the group presentation with minimum supervision of the instructor? What evaluation method could be developed and employed to determine effectiveness in helping students to reach the objectives of the unit?

Objectives were developed for the entire unit of frog dissection and anatomy. They were validated and evaluated by a biology faculty member who acted as a formative evaluator, as well as by 34 student volunteers representing the future target population. The revised objectives were used as a criteria for selecting instructional content, for determining procedures and for devising tests of the self-instructional package.

Recent literature was reviewed to gain insight into the development and portrayal of self-instructional materials. The development of the modules involved a team effort comprised of the author, College of DuPage Learning Resource Center Material Production personnel and the Director of Instructional Design Office, who guided and coordinated the development of the modules.

Two self-instructional modules were developed, which basically will serve as prototypes for completion of the remaining series. They include a printed packet as well as audio-visual presentations. Video-cassettes were developed for part of the learning activity, and projector-slides for part of the post-test.

A pilot test was conducted with six College of DuPage student volunteers representing the future target population. A comparison of pre-test and post-test results indicated that learning had taken place as a result of the developed instructional materials.

The evaluation results, performed by the students involved in the pilot-test, revealed that the module components were perceived as achieving their purposes and the student attitudes toward the teaching aid were positive. Module evaluation results, performed by the faculty, indicated that the package components met the basic criteria suggested by Hecht and Klasek (1974). The evaluation data indicated that the first two modules needed a few minor revisions.

It was concluded that the modules can be used as self-instructional tools aiding the students with varied abilities and learning styles. It was recommended to use the formed objectives as the criteria for selecting the materials for the module components, instructional procedures and the development of the tests, and complete the remaining module series using the basic plan of the two finished modules. Video-cassettes should be developed only for those modules

requiring audio-visual guidance to find the obscured anatomical parts and to provide alternative learning whenever possible.

It was further recommended to include the formed questionnaires for obtaining an ongoing evaluation and suggestions from students and from the faculty for improving the self-instructional modules.

To facilitate the diffusion of the module series, to aid instructors in helping the students to use the product most effectively, a "Teacher's Guide to Instructional Modules: Frog Dissection and Anatomy" was developed.

Once the modules are completed, they will provide an alternative to the conventional time-bound class instruction method for learning frog dissection and anatomy.

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Chapter I

INTRODUCTION

Background and Significance

The dissection of a frog is an integral part of the courses "Principles of Biological Science 102" and "Comparative Vertebrate Anatomy 201" at DuPage College. The students study the frog, because frogs can be easily obtained and dissected, and they show the major features of the organ systems characteristic of the backboned animals - the vertebrates like man. The experience and the knowledge gained during this unit should aid the students in future study and understanding of human anatomy.

Many College of DuPage students experience difficulty with the frog dissection and anatomy unit. They have difficulty in following printed directions, either because of low reading level or because they have a visual learning style -- a manner of learning highly dependent upon diagrams, illustrations and other visual aids. During the course of an academic year, more than five hundred College of DuPage students study the frog. The students come from different backgrounds, with varied abilities and with different learning styles. Yet, there are no provisions to enable them to study the present material at a slower or faster pace. Normally, the instruction of the unit is conducted by the faculty in a traditional manner using lecture discussion method during two class periods per week, and most of the reference materials are in a printed form. The video presentations that are available have been found to be quite incomplete and, thus, are seldom used. The objectives of the units are not always clear in the students' minds. If a class is missed, make-up work is often difficult. The students have little opportunity to obtain repeated instruction or to check their success and note their mistakes for possible correction. Usually, the testing is done not for the sake of noting deficiencies for improvement, but for the purpose of obtaining a grade evaluation.

The heavy class load is an important factor in preventing the College of DuPage staff from giving the desired individual instruction. Often students' and instructors' schedules do not coincide, thus preventing possibility for additional help. What strategies could be employed to aid these students in meeting the unit objectives?

A small scale instructional module, dealing with frog dissection, was developed (Vasiliauskas, 1978) as a practicum for the Nova University "Curriculum Development" unit. The intent was to find out if the College of DuPage biology students would perceive the method of presentation as a help in meeting the objective of that section of the course. The pitfalls associated with the first formative attempt were explored so that a base could be established for a larger project.

The evaluation results, performed by College of DuPage biology students and faculty, indicated that the concept was excellent for teaching frog dissection and anatomy, but that there were many flaws in the module itself. The module was too long and did not cover all the needed aspects of frog dissection. The visual presentation in the video-cassette needed improvement. The learning activity was too general. The principle finding, however, was that the development of modules, dealing with frog dissection and anatomy, was viewed as beneficial by College of DuPage students and faculty. Anticipating an additional avenue for learning an important segment in biology, the College of DuPage administration and the Instructional Design Office assured full support for a project which would provide an alternative to the conventional, time-bound instruction method for learning frog dissection and anatomy.

It was noted earlier that College of DuPage students taking "Principles of Biological Science 102" and "Comparative Vertebrate Anatomy 201" are a heterogeneous group. They vary in their biological studies background, abilities, reading skills and learning styles. Yet, there is no opportunity for self-paced learning. There are no specific provisions for make-up work, and consequently, a burden is placed on both the instructor and the student.

Research Questions

Given the nature of the problem, the following questions were asked:

1. What are the objectives of the frog dissection and anatomy unit?
2. In order to teach the unit of frog dissection and anatomy
    a. What strategy can be used and how can the teaching aids be developed and presented to help students who have poor reading skills, who are slow or fast learners, or who have visual learning style--a manner of learning highly dependent upon diagrams, illustrations and other visual aids?
    b. What kind of study path could be offered to aid the

student in making up the work missed in the group presentation, with minimum supervision by the instructor?

3. What evaluation method can be employed to determine effectiveness of the modules in helping students master the objectives of the unit?
4. How should an evaluation instrument be developed to receive input for improvement of the presented teaching aid?

The Purpose of the Major Applied Research Project

Based on the research questions, the following purposes evolved:

1. To formulate objectives for the entire unit of the course dealing with frog dissection and anatomy;
2. To develop one to two self-instructional modules for frog dissection and anatomy which will serve as a prototype for the remaining series;
3. To formulate the method and develop the instrument for the evaluation of the module series.

Definition of Terms

Biology 102 (Principles of Biological Science): a course dealing with anatomy and physiology of the vertebrate organisms.

Comparative Vertebrate Anatomy 201: a course dealing with vertebrates, their systems, organs, physiology and evolution. The frog is one of the organisms studied in the laboratory.

Evaluation: "... the process of the determining the decision areas of concern and selecting, collecting, analyzing and providing significant information to help decision makers choose among alternatives." (Akin and Fink, 1974:49).

Field test: a try-out on a large number of students, representing the target population, after the pilot-testing is completed and the initial revisions of the product are made.

Formative evaluator: a biology instructor who will appraise the module content and presentation before and during the production phase.

Formative evaluation: the appraisal of instructional materials during their stages of formulation and development. (Scriven 1967).

Learning activity: "... the terrain over which the student travels in the pursuit of the objectives of the unit" (Herrscher 1971:6).

Module revision: changes in the module which may be needed after its evaluation is made.

Objectives: the building blocks of the learning unit indicating what the student is expected to know or do at the end of the unit.

Pilot-test: a try-out of the product on a small number of the target population before dispersing the product to a larger group.

Post-test (post-assessment): samples the behavior called in the unit objectives, the purpose being "... to provide the learner with an evaluation of his progress and to provide the teacher with the information on the success of the unit so that he may improve it" (Roueche 1976:111).

Pre-test (pre-assessment): "... any set of related questions given before instruction, that is directly relevant to the knowledge, attitude or skill to be acquired." It defines learning deficiencies that may be present (Hartley and Davies 1976:241).

Prototype module: a model for the development of a self-instructional series in the future.

Rationale: a statement informing as to why it is important that the material is learned.

Self-instructional module: a self-contained instructional package capable of standing alone. It is a unit of instruction with a focus on well-defined objectives (Murray 1975:5). In addition, it contains a pre-test, learning activity and a post-test (Herrscher 1971 and Johnson and Johnson 1970).

Study path: a written or diagramatic description indicating the sequence of a learning task (Boyd, 1978).

Traditional (conventional) teaching methodology: the use of lecture and discussion in presenting the materials to be learned.

Target population: students who are representative of the population for which the learning module was designed.

Validation: the try-out, testing and revision period to insure that the instrument can accomplish what it intended to accomplish.

Visual learning style: a manner of learning highly dependent upon diagrams, illustration and other visual aids.

Assumptions

While undertaking the present Major Applied Research Project, the following assumptions were made:

1. There is a need for the development of a self-instructional module series dealing with frog dissection and anatomy.
2. The formulated objectives represent sufficient range for the study of the frog unit and serve as a base for development of the modules.
3. The fully developed modules will serve as useful prototypes for the development of the remaining series.
4. The modules will aid the poor readers and students who have visual learning styles, as well as accommodate the fast learners, to meet the unit objectives at their own pace.
5. The modules will provide make-up opportunities for students who miss class presentation.
6. Even though the modules themselves may not always be a better way to learn for all students, they will provide a functional alternative to the conventional, time-bound class instruction method (McNeil, 1976).
7. By using a biology faculty member as a formative evaluator during the process of module development, the inaccuracies and deficiencies were minimized before the modules entered the production stage.
8. The student and faculty evaluators of the modules can provide useful input in determining if the modules could serve the intended purpose of teaching the students frog dissection and anatomy.

9. Students evaluating the modules represent the future target population comprised of different abilities and varied learning styles.

Limitations

1. Two prototype self-instructional modules were completed, rather than developing the entire series dealing with frog dissection and anatomy.
2. The pilot testing was performed by a limited number of volunteers.
3. The effectiveness of the modules was not validated by field-testing during the Major Applied Research Project period.
4. The instructional worth of the modules and the evaluation data to be used for possible module revision recommendations was based on the results of a small population.
5. The designed module series may have limited application to other community colleges, since the procedures were not designed to create a universal product.

Organization of the Study

Chapter I has included the background and significance of the Major Applied Research Project, the research questions, the purpose of the project, the definition of terms, the assumptions and the limitations. A review of related literature will be found in Chapter II. The procedures will be explained in Chapter III, and Chapter IV will report the findings. Chapter V will offer summary, conclusions and recommendations. Bibliography appropriate to this study, as well as the appendices will be presented at the end of the report.

Chapter II

REVIEW OF RELATED LITERATURE

The review of literature focused on finding and developing the means to aid the College of DuPage biology students in learning frog dissection and anatomy outside the time-bound class instruction. Evaluation methods of the developed instructional material were also explored.

Development of Objectives for Frog Dissection and Anatomy Unit

Johnson and Johnson (1970) emphasized that the design process of any instructional system begins with specification of objectives. Russell (1974:15,16) elaborated the importance of clear objectives further, by stating that the development of clear objectives is important not only to the developer of the module, but also to the teacher teaching the unit, as well as the student taking it. He noted that:

> . . . the objectives give direction and focus; the developer knows where he is going before he begins designing instructional activities so that each medium and activity is aimed at meeting a specific objective. For the teacher, objectives give insight into the content and the appropriateness of the module for his students. For the student, they describe exactly what is expected of him and provide him with the goal to be mastered.

Tyler (1970:3) indicated that "these educational objectives become the criteria by which materials are selected, content is outlined, instructional procedures are developed and tests and examinations are prepared." Boston (1972:22) cautioned that "the development of a skill or knowledge must take place in phases or logical steps if the learner is to be successful with the learning experience. The same ideas were expressed by Esseff and Esseff (1976a), Johnson and Johnson (1970, 1971, 1975), Russell (1974) and others.

Bloom (1956) classified objectives in three major categories: a. cognitive -- dealing with the intellectual processes like solving a problem, listing, naming; b. affective -- dealing with feelings and attitudes like enjoyment, respect; and c. psychomotor -- dealing with manual skills like performing a task and constructing. He felt that the recall or memory was in the lowest cognitive level, while quantitative or qualitative was at the highest. Regardless of the objective domain, however, it is important that the developed objectives convey the same meaning to each person.

Esseff and Esseff (1976), Johnson and Johnson (1970, 1971, 1975), Mager (1963) and Thornwald (1968) stressed the need of expressing the objectives in terms of observable student behavior. The objectives should provide clear description of what the learner must be able to do in order to demonstrate his accomplishment of the objective. Kemp (1971), Mager (1963), Russell (1974) and other authors cautioned not to use "loaded" words which are open to a wide range of interpretations. Some of the presented examples of these terms were: to know, to understand, to appreciate. They emphasized the need to use action words in stating each task, because then the student and the instructor will be able to judge, through testing, whether or not the objective was achieved. Esseff and Esseff (1976a) provided the following examples indicating the use of action words: ". . . be able to show; be able to trace; be able to identify...." Kemp (1971) advised to keep the objective statements simple and brief.

Mager (1963) characterized the objectives as follows:

1. They describe the educational intent.
2. They describe what the learner will be doing when demonstrating his achievement.
3. They describe terminal behavior the conditions under which the behavior will occur and the criterion of acceptable performance.

McNeil (1973:170) stated that "learning theory and empirical data support the view that when there are clear statements of objectives, learning is more efficient and objectives are attained more readily."

Boston (1972 a,b), Drumheller (1972) as well as other authors stressed the need of describing the criteria for measuring the success of the performance and the establishing of the criteria for minimum performance.

Jenkins and Russell (1971) indicated that well written performance objectives will not only specify student competencies to be gained from the unit of study, but will also guide the developer in the design of the module. Thus, after the objectives are developed, the following questions were asked: "What strategy can be used and how can the teaching aids be developed and presented to help students who have poor reading skills, who are slow or fast learners or who have visual learning style -- a manner of learning highly dependent upon diagrams, illustrations and other visual aids? What kind of study path could be offered to aid the student in making up the work missed in the group presentation with minimum supervision by the instructor?

The Search for an Appropriate Teaching Strategy

The second major area of the literature search dealt with the development of a teaching strategy which would aid the students in learning frog dissection and anatomy without binding them to the classroom. Means of presenting the subject matter, which would aid the heterogenious student body having different abilities and varied learning styles, were also investigated.

Roueche (1976:12) pointed out that "the simple recognition of individual learning differences poses serious challenges to the usual group instruction." He noted that there is no single teaching method or style best suited to all students. Students learn in different ways and at varying rates of speed; thus, they need varied forms of instructional materials. Kemp (1968:5) elaborated this concept further by saying:

> ...students differ greatly in their ability to perceive and learn, and in their individual requirements for learning. Some learn easily and rapidly from printed and oral presentations, with minimum of more "direct" experiences. Others require experiences that are more concrete, including the use of visual media. Most students require a combination of various avenues of learning.

Similar thoughts were expressed by Brunner (1966), Coger (1975), Duane (1973), Hunter (1977), Jenkins and Russell (1971), Roueche and Pitman (1973), Russell (1974), and others.

Kemp (1968:5) indicated:

> ...with growing awareness, the process of education is shifting emphasis from teaching and the impairing of knowledge, directly from teacher to student, having greater concern for the learner - for his needs, for his interests, and for ways to structure instruction and motivate so he will be an active participator in the process of learning.

The Nova University syllabus (Herrscher, Roberts, and Roueche, 1973), dealing with curriculum development focused on individualized instruction as a means of improving and facilitating student learning. Herrscher (1971:10) stated that "one means of adapting a course to the individual learning rates of students is to develop units of the course on a self-instructional basis. These units become self-contained instructional packages dealing with a small amount of subject matter which forms a conceptual whole, capable of standing alone."

Module-based instruction can permit the student to pace his study according to his ability to assimilate information. It can render immediate positive reinforcement. Roueche (1972:38) advocated that "if clear objectives are presented and instructional sequence carefully designed to allow practice and feedback, the student knows where he is going and how he is doing throughout the learning sequence." He emphasized that "success breeds the desire for further success." If the students are given enough time and opportunity they will probably master the learning task.

According to Kulik, Kulik and Carmichael (1974), the self-paced, mastery-oriented instruction was used as early as 1919 in the public schools of Winnetka, Illinois. In the middle 1950's, B. F. Skinner and others led to formation of the basic teaching principles which became characteristic of programmed instruction. This concept proposed small-step instruction, active student involvement, immediate reinforcement and self-paced learning. It was not until the early 1960's that the concept of the individualized instruction began to spread. The Keller plan, Glazer's system of individually prescribed instruction and S. Postlethwaits audiotutorial approach established firm roots for modular instruction. The thrust of the 1970's is the design development and the utilization of minicourses which individualize learning in pace and intensity.

Herrscher (1971) summarized the basic ideas of numerous authors as to what should comprise an effective self-instructional module. He indicated that the module should include a rationale, objectives, pre-assessment, learning activity, post-assessment and the basis for revision of the unit.

Literature was examined to explore further the advantages of modular instruction. How can the modules be designed to help the students in meeting the unit objectives? What is the role of the student and the teacher under this method of instruction?

Washburn (1975:13-15) summarized Mager's universal positives and the components of systemic instruction:

1. Provide instruction in increments that will allow success most of the time.
2. Provide enough signposts so that the student always knows where he is and where he is expected to go.
3. Provide the student with statements of the instructional objectives that he can understand.
4. Detect what the student already knows and drop that from his curriculum (thus not boring him and teaching him what he already knows).
5. Provide feedback that is immediate and specific to the students' response.
6. Provide for student involvement.
7. Provide the student with some control over the length of the instructional session.

8. Make the use of those variables known to be successful in attracting and holding human attention, such as motion, color, contrast, varieties of personal reference.
9. Provide instructional tasks that are relevant to your objectives.
10. Use only those test items relevant to your objectives.

Kulik, Kulik and Carmichael (1974:382) indicated that in the modular instruction "... the students are told what they are to learn in clearly specified objectives, and are repeatedly tested for their mastery of these objectives in unit tests. Final examination necessarily covers the same ground. This is quite different from the conventional practice of not giving away the content of the final."

Modular instruction appears to be the answer for the slow and the fast learners for it provides self-paced learning opportunity. Roueche and Snow (1977:99) stressed that modules, focusing on student learning rather than holding the time-span as a constant, are especially significant teaching tools for the high-risk students of the Community College.

In modular instruction the difficult subject matter can be repeated as often as necessary. The slow learners are not forced to move prematurely to new material. Jenkins and Russell (1971:22) further noted that most modules use "... evaluation system which required mastery of the objectives to a prescribed criterion level of performance before the student proceeds to the next module in the sequence. This minimizes failure and helps to assure that the student has an understanding of the material before moving on to the next unit."

Jenkins and Russell (1971) further indicated that in modular instruction the emphasis is not on the class as a whole, but on the individual student. The instructor knows what each student is learning and can follow his progress.

The modules can aid the poor readers and the disorganized students for the modules provide the opportunity for organized sequences of experiences reflecting special interests of the instructor or the student (Creager and Murray, 1971). This kind of teaching strategy, according to Russell (1974:3), "... afford the opportunity to develop, evaluate and use a variety of media to optimize instruction for students on a given topic."

Using self-paced instruction, the student can develop a sense of responsibility for his own learning. Russell (1974:4) indicated a danger, however, for "due to the lack of interest, the student may not be motivated to study."

Thornton (1971:15) pointed out that "modules, of course, are only learning aids. Like any aids, they cannot replace the skilled teacher." Jenkins and Russell (1971:130) cautioned further that module instruction does not "... make teaching easier, but it does add new and different dimensions to the functions of educators."

Creager and Murray (1971) indicate that modules allow the instructor to focus on student deficiencies and reduce the routine aspects of instruction. Thus, the teacher is freed for personal contact with the students. He can act as a resource person, a motivator, a diagnostician as well as prescriber. The teacher becomes not the disseminator of knowledge but a director of learning. Russell (1974:130) further noted that modular instruction can free the teacher to help the students who have minor difficulties with the material. He can serve as a tutor and answer questions not discussed in the module.

Russell (1971:123) showed another advantage of modular instruction. Namely, "modules can be used to provide continuous learning experiences for students who miss specific instruction due to absenteeism. Modular instruction can be especially useful for students who are hospitalized or confined at home."

Finally, Postlethwait (1969) and Thornton (1971) pointed out that in modular instruction the failures can be pinpointed specifically to both the subject matter and the instructional failures. Subsequently, either area can be remedied in a minimum time and effort.

The studies conducted by Kulik, Kulik and Carmichael (1974), Lange (1966), Postlethwait (1969), as well as other literature search findings, indicated that modular instruction can be an effective avenue for learning a unit of study as well as provide an alternative to the conventional, time-bound class instruction method. As Russell (1974:96) indicated "modules can teach part of a course, all of a course or a total curriculum." Modules can be used for remedial instruction.

Russell (1971:39-43) presented the steps that are involved in designing a module. They are:

1. The development of exact specifications of objectives and what the student should be able to do after completing the module (terminal behavior).
2. The development of a pre-test which should indicate what capabilities the student already has, what he already knows about the topic or the process.
3. The sequencing of instruction and selection of media in order

to optimize the organization and presentation of the instructional materials and resources.

4. The construction of criterion items which can test objectively to determine whether or not the student has mastered the objectives.

Lastly, Jenkins and Russell (1971), Johnson and Johnson (1970), Russell (1974) as well as other authors suggested several try-outs and revision cycles in order to refine and upgrade the effectiveness of the material.

The remaining literature search dealt with the modular components. The formation of the objectives was already examined, thus, the next step was to find material dealing with the setting of a climate for modular instruction and the presentation of the rationale for the study of the unit.

Setting a Climate for Modular Instruction and the Presentation of the Rationale for the Study of the Unit

In discussing self-directed learning, Knowles (1975) stressed the importance of setting a warm climate with the student. He felt that the climate should consist of caring for each other and mutual respect even though the student and the author will never see each other. Through dialogue of the presentation of the subject matter, through active involvement of the student, a climate of mutual trust can be established. In preparing the instructional package Johnson and Johnson (1975:71) advised: "Pretend that you are talking to a student. Speak to him in the first person." The authors believe in using personal tone even in presenting the objectives. They advised to write: "You will need to know ... instead of the student will need to know...." They further said: "Pretend you are in one-to-one situation..., add humor and conversation to your package" in order to set the climate condusive to learning.

Climate setting is important even in the diffusion of the product. Kemp (1971:59) stated: "A positive attitude by the teacher and by any assistant can influence the attitude of students toward the acceptance of new instructional procedures."

Herrscher (1971), Johnson and Johnson (1970, 1971, 1975), Kemp (1968) and others felt that when the module is compiled, there is a need to include a section showing the students the relevance, the meaningfulness of the material to be learned. This section presents the rationale, a statement of purpose why it is important to learn the material. Creager and Murray (1971:6) wrote that "the statement of purpose should be an elaboration of the title of the module which relates the content of a specific module to the interests and needs of the student." The rationale explains the significance of the module as seen through the eyes of the author. Herrscher (1973b:17) stated that "students usually find course work relevant if it relates to their personal interests, applied to job or career objectives, provides background for future study in a subject area, enriches their everyday lives, or develops personal skills in areas recognized as important for social or professional mobility." If the students can see the relevance of the subject to be studied, they are more inclined to attain the prescribed objectives.

The Pre-test (The Pre-assessment)

In discussing the pre-test design, Hartley and Davies (1976:241) pointed out that pre-test consist of any set of related questions, or skill to be acquired. Roueche (1972:101) elaborated further by saying that "... the pre-test must provide a complete cross section of the behaviors required by individual learners (as stated in the unit objectives). Second, the pre-test should attempt to define (in terms of student responses to the test items) what kind of learning deficiencies are present." Hartley and Davies (1976) emphasized that pre-tests not only provide some measure of what the student already knows of the material to be taught, but they also can teach as well, for they increase student sensitivity to a learning situation. Lewis (1971;41) felt that "the student should receive an explanation of why he is taking the pre-test."

Learning Activity

Herrscher (1971:6) defined the learning activity as being "... the terrain over which the student travels in the pursuit of the objectives of the unit." The "Focus on Learning" conference (1978), Lewis (1971), Thornton (1971) indicated the importance of well developed, explicit learning activity to facilitate student involvement and thus, mastery of the task.

When preparing the learning activity one should remember, as Briggs (1967:18) explained, that "... there are qualitative differences among students in their learning styles, so that different kinds of stimuli are needed by different learners." Jenkins and Russell (1971:491) elaborated further by saying:

> Students differ in their responsiveness to different media. Some learn best through reading; others learn more from pictures and films; and still others must hear in order to understand. Some students need to get their hands on the object being studied.

Kemp (1971) believed that many students benefit from combination of the various approaches. The need of varied instructional strategies in the instructional system again was expressed by Bloom, Hastings and Madaus (1971), Brunner (1966), Hunter (1977) and other educators dealing with the development of self-instructional modules.

Russell (1974:3) presented examples of media and activities which could be incorporated in modular instruction. The examples were:

1. Reading, textbooks and articles
2. Examining diagrams and photographs
3. Viewing films and colored slides
4. Handling real objects and models
5. Studying demonstration materials
6. Listening to audio tapes
7. Conducting actual or simulated experiments
8. Discussing subject matter with other students and teachers

It should be remembered that before the student starts the pursuit of the learning activity, he must have the ability to understand the nature of the prescribed task and the procedures he is to follow. This is especially important if multi-media is involved in the learning activity. Boyd (1978) presented sequence of learning task in a flow chart form, which tells the student exactly what is to be performed and in what order.

Kemp (1971:59) noted that the person who prepares the instructional modules should realize that the "amount of material to be learned at any one time or in any one lesson must be related to the complexity and difficulty of the material items and the ability of students."

Postlethwait (1967), Russell (1974) and others indicated that a good learning module will give the students a role of active participation, for they learn by doing. Dale (1969) felt that the real life experiences like the handling of objects and performing of an experiment are concrete forms of instruction. The involvement of the student with simulated experiences and actual observations are more desirable than presenting an audio-explanation or directing to a printed source.

Kemp (1968) and Russell (1974) emphasized that careful selection and the sequencing of the media is important in order to optimize the organization in the presentation of the instruction. Duane (1973) indicated that selection of instructional methods and media should depend on the nature of the objectives. Russell (1974:71-72) advised: "As you select media, you must decide which combination of instructional activities and media will most effectively assist your students in meeting your objectives." Allen (1973), Murray (1976), Russell (1974) noted further, that each learning step in the module should be designed to build upon the knowledge or skills already learned.

Where visual aids are involved, Allen (1973), Kemp (1975), Murray (1971), Thornton (1971) and others stressed that variety is important. Allen (1973), Kemp (1975) and Postlethwait (1969) indicated that repetition and variation of stimuli are significant factors in learning of many skills and information. Specimens, diagrams, films and printed materials can be presented two or more times in identical or varied forms. Murray (1971:7) cautioned not to be locked into a fixed format. He further warned that "one should avoid complex diagrams, lengthy films or slide sequences, undigested tabular materials, elaborate models, and irrelevant photographs." Russell (1974:77) added by saying that the complex teaching aids tend to confuse rather than to clarify.

Jenkins and Russell (1971), Russell (1974) noted that audio-visual instruction frees student hands to manipulate materials. Students may be asked to analyze the visuals; the video presentation can be used in aiding the students to find parts and other information. A Study guide may be developed providing space for student responses to questions presented in the programed instruction.

Murray (1971:6-7) cautioned that "if an audio-tape is to be used, it is important to note that the central function of the tape is to integrate learning activities, not to deliver a lecture." Russell (1974:74) advised further: "... don't simply lecture on an audiotape. Talk with the students just as you would converse with them in one-to one situation." He urged: "Involve the students!" Russell (1974:55) added that "in order to maintain a flow of information, some subject matter is presented for continuity, but it may not be important for meeting the objectives."

In discussing the selection of visual aids, Glazer (1974) indicated that 35mm. slides can be converted to filmstrips, prints, overlays as well as be incorporated with the use of audiotapes. Kemp (1975), Kinder (1975) pointed out that the pictures have time value. Kinder (1975:33-34) explained further: "To be most effective, the picture should be single and uncluttered. Not only are single pictures more aesthetic, but their teaching value is superior." He felt that "unless the picture is purely of static things, it should show action."

In discussing the value of the different media, Kemp (1971:65) elaborated Kinder's (1975) idea by stating:

> A motion picture is a "transient" medium, requiring the student to grasp the message as the film is projected. A still picture is a "persistent" medium permitting the student to study the message at his own pace.

Kemp (1975:17) cautioned:

> Activities related to the presentation of a film indicate that learners experience difficulty in following a continuous demonstration and, at the same time, understanding the task

> themselves. But when the film or other continuous flow of information is stopped and the learner then participates, learning is more effective.

Kemp (1975) indicated further, that color film is more effective than pencil sketches of visuals, especially when the color discrimination contributes to learning. Verbal simplification of the audio-visual presentation, as well as printed titles, increase teaching effectiveness.

Even when the modules use audio-visual presentations, printed references may benefit the learners. Russell (1974) encouraged human interaction to facilitate learning. The interaction may be with the teacher or with other students.

Skinner (1954) believed that much of school activity is wasteful because rewards are not skillfully used. There is not enough reinforcement. According to Russell (1974:21), Skinner feels that "reinforcement refers to any of the wide variety of conditions which may be introduced into the learning situation whereby the probability of a given response occurring again in a similar situation is increased." Questions with a source of answers may serve the purpose. Verbal reinforcement could also be used. Even a post-test with immediate feedback of results may serve as reinforcement for learning. Russell (1974:24) emphasized that frequent feedback reduces the time required to attain mastery.

Kemp (1975) and Murray (1976) advised to examine materials already prepared on the general topic. They advised to survey and collect the materials which later may be used in the production of the modules.

While examining the various resources, it was found that there are numerous printed materials and audio-visual aids on the market dealing with frog dissection. However, they present mainly the finished product and do not always show the steps involved in finding the anatomical parts. Frequently the tests are hard to follow, and diagrams, while visual, are often highly dependent on the reading skills of the students. None of these materials use a self-instructional module format containing a clear rationale, objectives, pre-test and post-test. The learning activities are broad. There is no build-in feedback mechanism for noting success or failure. These study aids are highly dependent on the presence of an instructor to act as a guide in the learning process as well as in the evaluation of the achievement at any given point.

Of all the printed guides, Gilbert (1968), Underhill (1975), Wells (1964) and Walker (1967) were found to be most explicit and easiest to follow.

As shown in Table 1, major indexes of visual aids were used to obtain a list of visual and audio-visual presentations dealing with frog dissection and anatomy. It was found that most visual aids dealt with frog's natural history and development stages.

TABLE 1

Available Visual Aids Dealing With Frog Dissection And Anatomy

Reference	Title	Description	Source
A Directory of Self-Instructional Materials Used in Junior Colleges (1971)	--	--	--

Table 1 (continued)

Reference	Title	Description	Source
Educational Films (1972-75)	Frog Anatomy	18min. Film Frog dissection and an overview of body systems	Harding College
Educators Guide to Free Films (1978)	--	--	--
Educational Motion Pictures (1975)	*Frog Anatomy	17min. Film Frog dissection and an overview of body systems	Indiana University Audio-Visual Center
Film Evaluation Guide (no date)	--	--	--
Films too Good for Words: A Directory of Non-narrated 16mm Films (1972)	--	--	--
Index to 16mm Educational Films (1977)	--	--	--
Index to 35mm Educational Filmstrips (1977)	Biology Dissections: The Frog	Frog Dissection and an overview of body systems; with sound	Jam Handy
	Frog, The Basic Dissection	Single filmstrip; overview with captions	Eye Gate House, Inc.
	*Frog Anatomy	Frog development dissection and an overview of body systems with sound	Carolina Biological Supply Co.
Index to 8mm Motion Cartridges (1977)	The Anatomy	A series dealing with frog dissection and an overview of body systems	Thorne Films

Table 1 (continued)

Reference	Title	Description	Source
Index to 8mm Motion Cartridges (1977) continued	Frog Dissection	A series of cartridges, 2 to 4min. each dealing with frog dissection and anatomy	Rank Audio Visual L.T.D.
	Frog Dissection	Series on frog dissection with a test film	Holt, Rinehart and Winston
	*Frog Anatomy	Series of cartridges dealing with frog dissection	Encyclopedia Britannica Films, Inc.
	Other similar series available		
Index to Educational Slides (1977)	Frog Anatomy and Dissection	20 frames with a script; an overview	Society for Visual Education Inc.
Index to Educational Video Tapes (1977)	--	--	--
Index to Overhead Transparencies (1977)	Frog Anatomy	A series	Carolina Biological Supply Co.
Learning Directory (Westinghouse, 1970-71)	The Frog	Anatomy series 8mm loops	Encyclopedia Britannica
	The Frog	Anatomy series 8mm loops	NASCO
	Frog Dissection	Series of 8mm loops	Ealing Films
	Frog: Internal Anatomy	2 Transparencies; Vental and Side view	Creative Visuals

Table 1 (continued)

Reference	Title	Description	Source
Learning Directory (Westinghouse, 1970-71) continued	The Frog	Transparencies on Internal Structures	Eye Gate House
Programmed Learning: A Bibliography of Programs and Presentation Devices	--	--	--
Other Sources	Dissection of the Frog	Silent filmstrip	Hulton Educational Publ.
	Dissection Guide for the Frog	Filmstrips with captions	Projected Programs Inc.
	Dissection of a Frog	Filmstrips	Library Filmstrip Center
	Frog Anatomy	A film with an overview	U. of Ill. Visual Aid Service

Table 1 indicates that there is still a variety of visual/audio-visual materials dealing with frog dissection and anatomy. The available visual aids, however, present mainly an overview of frog dissection and body systems, and do not render themselves to be incorporated into the modular format of the already developed objectives. The models and charts of frog anatomy, which were not included in Table 1, do not provide enough guidance to find the needed parts.

Samples of modules using a programed format were also examined: Boyd (1978), Dodge and McDonald (1971), Krueger (1972), Kurtz (1971), Lewis (1971), Musgrave (1975), Russell (1974), Thornton (1971) and Withers (1971).

The examination of the developed modules and the visual aids proved to be of great value, because a composite picture emerged for "do's" and "don'ts" during the anticipated production of audio-visuals to fit the objectives of the College of DuPage biology courses. But how can one develop modules, using audio-visuals, without previous experience?

Planning and Developing of Modules Involving Audio-Visual Aids

Kemp (1975) advised to develop objectives and consider individuals who can assist in planning and production of the product. Kemp (1975), Murray (1976) and Russell (1974) advised to consult the specialist as well as others who are knowledgeable in the subject area. Kemp (1971:86) indicated that "instructional planning is not a "one-man show." There are numerous skills that are needed and they could be supplied by the members of a planning team.

According to Kemp (1971:86), the teacher should specify the learning objectives, select instructional methods, guide the learning experience, analyze student progress, design the evaluation instrument and interpret the results.

The second member of the production team should be an instructional designer, who is experienced in instructional design plan, knowledgeable about teaching/learning patterns and about instructional resources of all types. He must guide the planning process and coordinate the program.

The third area deals with the media specialist who should know the advantages and limitations of all instructional media. The technical staff should be responsible for photography, the art work, the lighting and the sound recording. Kemp (1971) recommended that another subject specialist would check the accuracy of the subject content.

Once the learning activity is completed, the next segment of modular instruction development is the post-test.

The Post-Test (Post-Assessment)

According to Roueche (1976:111), the post-test samples the behavior named in the unit objectives, the purpose being "... to provide the learner with an evaluation of his progress and to provide the teacher with the information on the success of the unit so that he may improve it." Murray (1971) indicated that the post-test should provide an index of learners accomplishments. Russell (1974:54) elaborated by saying that the post-test "... allows the student to pinpoint areas of weakness or omissions in his learning."

Russell (1974) and Skinner (1968) indicated that the post-test can serve as reinforcement device facilitating learning. Skinner (1968: 156) stated: "If mediated devices are not set up, if the student not automatically reinforced for knowing that he knows he stops working, the aversion by-product of not knowing build up." On the other hand, Russell (1974:24) suggested that: "As a student finds the effort rewarding, he is likely to spend more time on a particular learning task."

Lewis (1971) felt that the students should be given the purpose for taking the post-test and they should be encouraged to evaluate themselves.

Russell (1974:56) presented general rules for forming the post-test:

1. The test items must measure stated objectives in order to be valid.

2. Clear and complete instructions for answering or performing each item should be provided.
3. The type of criterion items used to evaluate a specific objective should be appropriate for the objective. Avoid using only one kind of test items throughout the module.
4. The vocabulary level of the test should be approximately matched to the range of ability of the students.

Russell (1974:57) further advised: "Restrict each statement to a single idea or principle. Items with several parts are often confusing." In matching questions "the instructions should indicate the basis for matching and state whether the answer may be used more than once and whether more than one answer is to be given for any one question." Russell believed that in matching questions "there should be extra choices in the answer column to avoid selection by the process of elimination."

As it was indicated earlier, there should be a prescribed criterion level of performance. The student should reach the indicated level, before he proceeds to the next module in the sequence. Musgrave (1975) emphasized that a remediation procedure should be provided so that the student would be aware as to what he must do if he was unable to complete the post-assessment satisfactorily.

Bloom, Hastings and Madaus (1971:20) explained that the evaluation should be both formative and summative in its scope. "Formative evaluation, as the name implies, intervenes during the formation of the student, not when the process is thought to be completed. It points to areas of needed remediation so that immediate subsequent instruction and study can be made more pertinent and beneficial." The authors noted that "summative evaluation has as its primary goals grading or certifying students...." Thus, the students should be aware of the purpose of the post-test and the possibility of periodic summative tests.

Bloom, Hastings and Madaus (1971) felt that most students, perhaps over 90 percent, can master the subject matter to be taught. The task of the educator is to devise the methods and materials which will help the students to achieve such mastery. Carroll (1963) emphasized that aptitude is a measure of learning rate and not achievement level. Thus, given enough time, students should attain mastery of a prescribed task. He indicated that the main role of an educator is to teach and not to evaluate aptitude.

The next section of literature search dealt with module evaluation. Is the developed module an effective teaching tool? How can it be improved?

Module Evaluation

Literature was reviewed in order to learn more about the purpose of evaluation, the stages of evaluation, the methods of evaluation and the procedures for treating data.

Diamond and others (1975:77) pointed out that "evaluation must be an integral component of any instructional development process." Akin and Fink (1974:49) defined evaluation as "... the process of determining the decision areas of concern and selecting, collecting, analyzing and providing significant information to help decision makers choose among alternatives."

Scriven (1967) stated that the major goal of evaluation was to obtain bases for judging the merits of programs. To accomplish this goal he introduced the concept of formative and summative evaluation. He believed that the focus of formative evaluation was to obtain feedback for the purpose of program improvement while still in the developmental stage. The focus of the summative evaluation was predicated on the eventual worth of the program when it reached a certain degree of stability. Johnson and Johnson (1970), Lawson (1974), Russell (1974) and others expanded the idea further by saying that formative evaluation results are important, for they can indicate if the instructional product components are or are not effective prior to the final release of the material to a large group of students. During the evaluation period the errors can be discovered, new objectives can be added, existing objectives can be modified and the learning activity medium can be altered to help in reaching the objectives more effectively.

Cavert (1974:239) indicated that in order to determine whether the end product of the instructional design is good, to determine if the mediated instruction is effective, "... it has to be displayed to the target population under appropriate conditions to see whether the specific objectives, for which the effort was designed, have been reached with consistency to predict universal results." The evaluators, representing the target population, may be volunteers or may be picked by randomized selection. McNeil (1976) cautioned that volunteers may be motivated students and thus, present slightly different results than the members of the group selected at random.

Russell (1974:42) emphasized: "The responsibility for learning is placed upon the individual student, but if a sizable portion of the students fail to achieve the terminal behavior, it is probably the fault of the instruction and not the student."

To evaluate the developed product Diamond and others (1975), Johnson and Johnson (1971) suggested several possible sources: faculty input, student observations and student performance on tests. The authors advised first to use the subject specialists to test the accuracy and the content of the product. Identify the problems and make the necessary changes. During the second stage of evaluation Espich and Williams (1967), Johnson and Johnson (1970), proposed to use one student. They believed that the learner can aid to uncover many program inadequacies. Espich and Williams (1967) suggested to use a slower student, for he will probably stumble more often. The stumbles could be removed before the product is diffused to a larger population.

During the third phase of product evaluation, Johnson and Johnson (1970) advised to pilot-test the instructional package using two to five students. After the revisions are made, Diamond and others (1975), Esseff and Esseff (1976f), Johnson and Johnson (1970) believed that a field-test, using several students, is in order. Esseff and Esseff (1976f) felt that one should use a minimum of ten to fifteen students to validate the product. Several try-outs and revisions were suggested to insure that the instructional-instrument can accomplish what it intended to accomplish.

To obtain module evaluation data, Diamond and others (1975), Herrscher (1971), as well as other authors, suggested questionnaires, interviews and test item analysis. Herrscher (1971), Johnson and Johnson (1970) Sorenson (1973) cautioned, however, that it is not enough to measure the attainment of the objectives, some measure should be included which would determine if there is a positive attitude to the instructional package.

Diamond and others (1975), Hecht and Klasek (1975), Johnson and Johnson (1973), Lawson (1974), Roueche, Washburn and Mink (1976), Russell (1974) and Washburn (1975) presented assessment instruments of instructional materials which were valuable not only in the formation of evaluation instrument of the developed product, but also in the development of the self-instructional modules.

While discussing the merits of the different methods of evaluation Nelson (1972) indicated that it was impossible to predict the accuracy of the value system of individuals. Consequently the questionnaire responses may not be precisely accurate. The questionnaires have certain advantages, however, for they can be distributed quickly, they can be standardized and answered by respondents at their own pace. The respondents anonymity could be maintained. Diamond and others (1975) felt that though the interview method (structured or unstructured) can be powerful, it may be difficult to reduce or analyze the results. Nevertheless, interviews can be very useful in identifying logistical problems, special weaknesses of instructional materials and other problems. Interviews can help to guard against false interpretations.

Depending on the method of performing the evaluation, the evaluators may be asked to present oral or written comments, rate topics, or use the "yes" or "no" response. Tabulated data may be compared against a set significance level or may be used in developing of a profile which can be examined and assessed.

Russell (1974) urged to explain to students the rationale for module try-out and evaluation. Espich and Williams (1967) felt that the programmer should indicate to students what he is looking for and that he expects them to point out the areas that are confusing. Through testing and revision, eventually, an effective teaching/learning instrument can be developed.

Once the instructional modules are developed, how does one diffuse the product?

Diffusion Strategies

Literature was examined in order to find an effective method for the diffusion of the newly developed modules.

Diamond and others (1975) warned that there is always resistance to change. Instructors may feel that the self-instructional modules present a threat to their security. Wolf (1975) proposed to create target audience awareness of the developed product. He suggested to approach the individuals who have position and status.

During the first stage of product diffusion, Wolf (1975) advised to focus upon individuals who are known to modify their educational practices routinely. These individuals may extend the diffusion of an innovation to other groups. The author suggested to develop a workshop and invite other instructors to observe a demonstration. Diamond and others (1975) indicated that "... the developer should present the general concept of course structure and describe how the student will operate within it." Once the faculty accept the concept, they in turn, will be able to acquaint their students with the alternative method of instruction and explain the possible reasons for its use.

Russell (1974:129) indicated that "before implementing modules, it is imperative that the teacher be thoroughly aware of the entire sequence of modules to be used in the course." Krueger (1972) and other textbook authors used a "Teachers Guide" as means of aiding the instructor in helping the students to use the product most effectively.

The literature emphasized that the development of effective instructional materials is a complex process requiring a great amount of thought and planning. Numerous authors indicated that students exhibit indivdual learning differences and learning preferences. It was noted that there was a need to provide an alternate path of learning to the lecture-demonstration methods used in the normal classrooms and that the printed instructions are not effective with all students, for many show reading difficulties, while others have a visual learning style.

It was emphasized by numerous educators that instructional modules could be designed to adapt the study units to the individual learning rates. Modules can be developed which exhibit clarity, self-pacing, organization, clear sequencing, and provide the opportunity for practice and reinforcement.

It should be noted that modular instruction is not free of problems. According to Kulik, Kulik and Carmichael (1974), modular instruction has shown higher withdrawal rates than the time-bound classes. They attributed this factor to the delay in starting the course, the delay in taking the tests and general procrastination. They indicated, however, that the problem could be reduced by indicating to the students a recommended schedule for passing the units which would yield steady rate of progress. Creager and Murray (1971) suggested that a teacher can act as a motivator to insure that learning is taking place.

Composite Protocol for the Development of Modules Using Audio-Visual Aids

The examination of literature dealing with self-instructional module development involving audio-visual aids, revealed the following protocol for the effective teaching product development:

1. Select a title.
2. Develop objectives
3. Survey literature for ideas.
4. Consult with others knowledgeable in the subject area.
5. Divide the subject content into small units of study -- the

modules, which should exhibit the following:

   a. The modules should contain the rationale, objectives, pre-test, study path, learning activity, post-test and the basis for revision.
   b. The modules should provide active student involvement, immediate reinforcement and permit self-paced learning.
   c. The modules should provide varied forms of instruction to accommodate the varied learning styles.
   d. The modules should indicate the set level of acceptable performance and provide guidance in remediation of the missed task.

6. Use a planning team for the development of the product, especially if visual-aids are involved:
   a. The teacher (subject specialist)
   b. Instructional designer
   c. The media specialist
   d. The technical staff
7. Evaluate the modules:
   a. In order to judge the merits of the program.
   b. In order to find the areas of weakness so that revisions could be made.
8. Develop product diffusion strategy.

Chapter two included literature search to aid the development of the self-instructional modules dealing with frog dissection and anatomy. Chapter three will present the procedures that were involved in the Major Applied Research Project.

Chapter III

PROCEDURES AND METHODOLOGY

The Major Applied Research Project dealt with the development of two self-instructional modules dealing with frog dissection and anatomy, which will serve as prototypes for the remaining series. The purposes for the study were established in Chapter I. This chapter sets forth the procedures that were followed to achieve each purpose.

The first purpose was to formulate objectives for the entire unit of the course dealing with frog dissection and anatomy.

1. Literature was reviewed to gain insight in forming objectives.
2. Objectives were formed for the entire series of thirty-one modules. Their development was based on the criteria described by Bloom (1956), Esseff and Esseff (1976), Johnson and Johnson (1970), Mager (1963) as well as other authors. The objectives were written using action words describing what the learner will be able to do in order to demonstrate his accomplishment of the task. The standards of acceptable performance were indicated in the post-test.
3. The objectives were validated by a biology faculty member who served as a formative evaluator. The evaluator had taught the "Principles of Biological Science 102" and the "Comparative Vertebrate Anatomy 201" for which the modules were designed and thus, was familiar with the needs of this unit of study.
4. The evaluation of the objectives, by the formative evaluator,

was performed using an interview method with the author. The major questions asked were the following:

a. Are the developed objectives consistent with the purpose and the rationale of the instructional unit?

b. Do the objectives cover wide enough scope for the given courses?

c. Are there any objectives that should be deleted, added or expanded?

d. Are the objectives clear?

e. Are the objectives specific?

f. Are the objectives measurable?

g. Are the objectives appropriate in number for the level of difficulty of each given module?

h. Are there any mistakes in the subject content of the presented objectives?

5. The input of the formative evaluator was assessed resulting in the first revision of the objectives.

6. A decision was made to pilot-test the revised objectives with students who represented future target population, before other components of the modules were developed.

Thirty-four student volunteers participated in the evaluation of the objectives; sixteen from "Principles of Biological Science 102" and eighteen from "Comparative Vertebrate Anatomy 201." The student evaluators were enrolled in classes where the learning of frog dissection and anatomy took place in a traditional, time-bound class instruction environment. They had no opportunity to receive pre-tests and they knew that the formal tests will be given not to note areas needing improvement, but to obtain a grade evaluation. There was already a prescribed standard level of performance using non-fluctuating percentage for each evaluation grade.

The form used in evaluating the objectives of each module (Appendix B) was based on Lawson (1974). The evaluation items concentrated on the clarity of the performance action of the developed objectives. The evaluation had six main purposes:

a. To find out if the objectives told the students what they were expected to do in the module;

b. To find out if the objectives told the students what they should be able to do at the successful completion of an assignment;

c. To discover if the objectives were specific;

d. To ascertain if the number of objectives for a given module was reasonable;

e. To find out if the students perceived the objectives as being measurable;

f. To develop a list of objectives which were not clear so that revisions could be made.

7. The student input was assessed and a second revision of the module objectives took place. (The revised objectives are found in Appendix A)

The second purpose was to develop two self-instructional modules for frog dissection and anatomy which will serve as a prototype for the remaining series.

When the idea of producing the self-instructional modules using audio-visual aids was born, it was realized that there would be a need for numerous skills in order to develop the product. The plan was presented to College of DuPage administration and to the Director of Instructional Design. Once the idea was approved, the design and development of the modules involved a team effort coordinated by James Boyd, the College of DuPage Director of Instructional Design. Boyd, as well as the Learning Resource Center personnel, were used in consulting and production of the modules.

1. The author specified the module objectives.

2. The developed objectives were used as a criteria by which the materials for module components were selected, content outlined, instructional procedures were developed and the tests were prepared.

3. Literature was reviewed in the area of developing self-instructional materials, designing pre-assessment and post-assessment tests.

4. Existing self-instructional modules, in related fields, were studied in order to learn more about the treatment of learning activities as well as other module components.

5. Existing printed materials and visual aids, dealing with frog dissection and anatomy, were analyzed for content, modes of presenting the subject matter and possible references for the learning activities in the modules which were to be developed.

6. Literature was reviewed to gain better insight into audio-visual instruction design and presentation.

7. Two self-instructional modules were developed comprising of:

   a. Printed packet containing:
      (1) Introduction to Instructional Modules: Frog Dissection and Anatomy (Appendix C) which includes:
         (a) Preface
         (b) Rationale for the study of the frog
         (c) Caution and advice section

(d) Needed equipment and materials for the study of the modules
(e) General directions
(f) List of the modules (including those to be developed in the future)

(2) Components of the first two modules (Appendix F and I):
  (a) Objectives
  (b) Pre-test
  (c) Study-path
  (d) Part of the learning activity
  (e) Part of the post-test

b. Video-cassettes presenting a part of the learning activity;

c. Projector-slides presenting a section of the post-test.

8. Module component selection was based largely on the Johnson and Johnson (1970) and Herrscher (1971) model.

9. The author developed the components of the printed packet. College of DuPage Production Division of the Learning Resource Center personnel aided in the selection, the lay-out and the art work of the modules.

10. The author presented general instructions to the production staff indicating the needs for the audio-visuals (Appendix D and G).

11. The author wrote a rough script for the learning activity video-cassette presentation. The College of DuPage graphic design consultant rewrote the script indicating and coordinating exact video treatment and audio aspects of the production. (The finalized video script is found in Appendix E and H.)

12. The video-cassette script was reviewed by a team comprised of the author, the direction of instructional design and the graphic design consultant, aiming for clarity in sequence and subject content.

13. After the second revision, the script was sent to the biology

faculty member who served as a formative evaluator.

The evaluator was asked to provide input in any area needing change or improvement. She was asked to indicate any mistakes that may be present in the subject content. After one more minor revision, the script was finalized for taping.

14. The video-cassettes were taped by College of DuPage Production Division of the Learning Resource Center staff.

15. The post-test projector slides were made using the specifications developed by the author. The frog anatomical parts were photographed by the Production Division staff working closely with the author.

16. Once the components of the two prototype modules were finalized, they were ready for evaluation.

The third purpose of the Major Applied Research project was to formulate the method and develop the instrument for the evaluation of the module series.

1. Literature was reviewed in order to gain insight into the development of evaluation instruments.

2. Questionnaires were designed and used to receive input from students and faculty about the module content, as well as to assess student opinions of the learning experience.

3. The design of the first evaluation instrument (Appendix K) was based on Hecht and Klasek (1974). It required to check that all module components suggested by Johnson and Johnson (1970) and Herrscher (1971) were present and provide an analysis of each. In addition, the evaluation instrument contained a section for comments relating to areas of concern and requested suggestions for improving the module series. After validating the questionnaire with a faculty member, evaluation of

the self-instructional package was performed by the module series developer, as well as by two College of DuPage faculty members: the formative evaluator and the College of DuPage Director of Instructional Design.

4. The second module evaluation instrument (Appendix L) was designed to obtain student input. It consisted of analysis of the module components. The instrument solicited views as to whether the modules can help the students in learning frog dissection and anatomy in a stimulating and desirable way. The above evaluation instrument was a questionnaire consisting of two parts. The first part involved rating of topics, while the second part sought written comments and suggestions for the improvement of the module series.

The questions dealing with student opinions of the learning experience were based largely on Roueche, Washburn and Mink (1974). The evaluation instrument was validated by two biology students using an interview method. Each item was discussed with the author to insure clarity of the statements.

5. A pilot test was conducted with six College of DuPage biology student volunteers who have not studied the frog before. Pre-test and post-test data was collected to demonstrate that learning has taken place as a result of the developed instructional material.

6. There was no control group to compare the results of modular instruction and the conventional classroom teaching method, because the intent was to find out if learning can take place using these modules and not which method was more effective.

7. The evaluation of the modules using evaluation instrument (Appendix L) was performed by six students involved in the pilot testing

of the modules after they completed the series.

8. Since the module evaluation population was small, rather than setting a significance level, a profile of the responses to each item was developed, examined and assessed.

9. The evaluation data received from the students and the faculty was used to devise recommendations for future revisions of the modules and the development of the remaining series.

"Teachers Guide to Instructional Modules: Frog Dissection and Anatomy" was developed, in order to facilitate the use of the modules; in order to enhance their diffusion (Appendix J).

1. Existing teacher guides, in related fields, were examined.

2. The selection of the developed teachers guide components were based on the criteria indicated by Hecht and Klasek (1974) as well as Krueger (1972).

The procedures and methodology involved in the Major Applied Research Project were presented in Chapter III. The findings will be discussed in the next chapter.

Chapter IV

FINDINGS

The preceding chapters dealt with an introduction to the study, the background and significance of the problem, a review of literature and a presentation of procedures used in development of self-instructional modules dealing with frog dissection and anatomy. This chapter presents the results of the procedures which were described in Chapter III.

Literature was reviewed to gain insight into the development of the objectives and portrayal of self-instructional materials. The finding stressed the importance of specification of objectives prior to designing the instructional system. Bloom (1956), Esseff and Esseff (1976), Johnson and Johnson (1970), Mager (1963) as well as other authors emphasized the need of using action words in presenting the objectives. They insisted that the objectives should be measurable and describe what the learner will be able to do in order to demonstrate his accomplishment of the task. The authors indicated that the number of objectives for a given study unit should depend on the level of difficulty of the presented tasks.

Consequently, the objectives, for the entire thirty-one modules dealing with frog dissection and anatomy, were formed using the criteria presented by the above authors. The formative evaluator, who validated the objectives using an interview method with the author, indicated that the developed objectives were consistent with the purpose and the rationale of the instructional unit. She felt that they covered wide enough scope for the given course and that there was no need for any deletions or additions. She indicated a problem in the terminology of module three, which was corrected during the first revision. The evaluator felt that the objectives were clear, specific, measurable and appropriate in number for the level of difficulty of each given module. She indicated that there were no mistakes in the subject content of the objectives, but there were several typographical errors which subsequently were corrected.

The revised objectives were pilot-tested with 34 students who presented the future target population: Sixteen students from "Principles of Biological Science 102" and eighteen from "Comparative Vertebrate Anatomy 201." The evaluation form (Appendix B) consisted of two major parts: a) rating of topics, b) responding to two open-ended statements. Tables 1-5 indicate the findings as indicated by the rating of topics.

TABLE 1

Student Perceptions of Module Objective Clarity in Indicating the Prescribed Tasks

Statement: By reading the objectives, I know what I am expected to do in the module

Module	Strongly agree 1		Agree 2		Tend to agree 3		Tend to disagree 4		Disagree 5		Strongly disagree 6	
	Bio. 102	Zoo. 201	Bio. 102	Zoo. 201	Bio. 102	Zoo. 201	Bio. 102	Zoo. 201	Bio. 102	Zoo. 201	Bio. 102	Zoo. 201
1	16	18										
2	15	17	1	1								
3	13	15	3	3								
4	15	17	1	1								
5	15	17	1	1								
6	14	16	2	2								

Table 1 (continued)

Statement: By reading the objectives, I know what I am expected to do in the module

Module	Strongly agree 1		Agree 2		Tend to agree 3		Tend to disagree 4		Disagree 5		Strongly disagree 6	
	Bio. 102	Zoo. 201	Bio. 102	Zoo. 201	Bio. 102	Zoo. 201	Bio. 102	Zoo. 201	Bio. 102	Zoo. 201	Bio. 102	Zoo. 201
7	14	16	2	2								
8	14	16	2	2								
9	16	18										
10	15	17	1	1								
11	14	13	2	5								
12	13	13	3	5								
13	13	13	3	5								
14	16	18										
15	13	13	3	5								
16	16	18										
17	12	16	4	2								
18	15	15	1	3								
19	16	18										
20	16	18										
21	16	18										
22	16	18										
23	16	18										
24	16	18										
25	15	18	1									
26	15	18	1									
27	15	18	1									
28	15	17	1	1								
29	16	18										
30	13	14	3	4								
31	14	15	2	3								

The students of the "Principles of Biological Science 102" and the "Comparative Vertebrate Anatomy 201" agreed that by reading the objectives they did know what they were expected to perform in the modules.

TABLE 2

Student Perceptions of Module Objective Clarity in Indicating What the Student Should be Able to Perform at the Completion of the Assignment

Statement: The objectives tell me what I should be able to do at the successful completion of an assignment.

Module	Strongly agree 1		Agree 2		Tend to agree 3		Tend to disagree 4		Disagree 5		Strongly disagree 6	
	Bio. 102	Zoo. 201	Bio. 102	Zoo. 201	Bio. 102	Zoo. 201	Bio. 102	Zoo. 201	Bio. 102	Zoo. 201	Bio. 102	Zoo. 201
1	16	18										
2	15	17	1	1								
3	12	14	4	4								
4	15	17	1	1								
5	15	17	1	1								
6	15	17	1	1								
7	15	17	1	1								
8	15	17	1	1								
9	14	16	2	2								
10	15	17	1	1								
11	15	17	1	1								
12	13	16	3	2								
13	13	13	3	5								
14	13	13	3	5								
15	16	18										
16	16	18										
17	14	16	2	2								
18	14	16	2	2								
19	16	18										
20	16	18										
21	16	18										
22	16	18										
23	16	18										
24	16	18										
25	14	18	2									
26	14	17	2	1								
27	14	17	2	1								
28	16	17		1								
29	13	14	3	4								
30	15	17	1	1								
31	16	18										

The students of the "Principles of Biological Science 102" and the "Comparative Vertebrate Anatomy 201" agreed that the objectives indicated what they should be able to do at the successful completion of the assignment.

TABLE 3

Student Perceptions of Module Objective Specificity

Statement: The objectives of each module are:

Specific ------------------------------------General

Module	Extremely 1		Moderately 2		Median 3		Moderately 4		Extremely 5	
	Bio. 102	Zoo. 201	Bio. 102	Zoo. 201	Bio. 102	Zoo. 201	Bio. 102	Zoo. 201	Bio. 102	Zoo. 201
1	16	18								
2	16	18								
3	12	17	3	1	1					
4	15	17	1	1						
5	16	18								
6	13	15	3	3						
7	13	15	3	3						
8	13	15	3	3						
9	13	15	3	3						
10	14	15	2	3						
11	12	16	2	2	2					
12	16	18								
13	15	18	1							
14	16	18								
15	15	16	1	2						
16	16	18								
17	16	18								
18	15	17	1	1						
19	13	16	3	2						
20	16	17		1						
21	16	18								
22	16	18								
23	16	18								
24	15	17	1	1						
25	16	18								
26	16	18								
27	16	18								
28	16	18								
29	13	16	3	2						
30	14	18	2							
31	16	15		3						

The students of the "Biological Science 102" and the "Comparative Vertebrate Anatomy 201" indicated that the objectives were specific.

TABLE 4

Student Perceptions of the Appropriateness of the Number of Objectives for Each Given Module

Statement: The objectives of each module are

Numerous -- Few

Module	Extremely 1		Moderately 2		Median 3		Moderately 4		Extremely 5	
	Bio. 102	Zoo. 201	Bio. 102	Zoo. 201	Bio. 102	Zoo. 201	Bio. 102	Zoo. 201	Bio. 102	Zoo. 201
1					16	18				
2					16	18				
3					16	18				
4					16	18				
5					14	17	2	1		
6					16	18				
7					16	18				
8					16	18				
9					15	14	1	4		
10					16	18				
11					16	18				
12					16	18				
13					16	18				
14					16	18				
15					16	18				
16					14	14	2	4		
17					16	18				
18					16	18				
19					15	18	1			
20					14	16	2	2		
21					16	18				
22					16	18				
23					16	18				
24					16	18				
25					16	18				
26					16	18				
27					16	16		2		
28					16	18				
29					13	14	3	4		
30					16	18				
31			1	1	15	16		1		

The majority of the students of "Biological Science 102" and the "Comparative Vertebrate Anatomy 201" indicated that the number of objectives in each module was appropriate.

TABLE 5

Student Perceptions of Module Objective Measurability

Statement: The objectives of each module are

Measurable ------------------------------------ Non-Measurable

Module	Extremely 1		Moderately 2		Median 3		Moderately 4		Extremely 5	
	Bio. 102	Zoo. 201	Bio. 102	Zoo. 201	Bio. 102	Zoo. 201	Bio. 102	Zoo. 201	Bio. 102	Zoo. 201
1	16	18								
2	16	18								
3	14	14	2	4						
4	15	18	1							
5	16	18								
6	16	18								
7	16	18								
8	16	18								
9	16	18								
10	16	18								
11	15	15	1	3						
12	16	18								
13	16	18								
14	16	18								
15	16	18								
16	16	18								
17	13	17	1	1			2			
18	16	18								
19	16	18								
20	16	18								
21	16	18								
22	16	18								
23	16	17		1						
24	16	18								
25	16	18								
26	16	18								
27	16	18								
28	16	16		2						
29	16	18								
30	16	18								
31	16	18								

Majority of the students of the "Biological Science 102" and the "Comparative Vertebrate Anatomy 201" indicated that the objectives of the modules are measurable. Two students felt that module 17 objectives were moderately non-measurable.

No responses were received from the statement: "Please list the objectives that do not indicate clearly what you are expected to do for the prescribed task." A few students wrote that everything was very clear.

The evaluators did not present a list of objectives needing modification. Several students, however, asked the following questions:

a. During the test, will the bones of module 6, 7, 8, 9, and 10 be completely articulated, partially articulated or disarticulated and tested individually?

b. If there is more than one name for a bone, muscle, or any other anatomical structure, should both names be known or is there a choice in learning only one?

In addition, the students suggested changing the sequence of presenting the objectives of modules 11, 17, and 18, in order to proceed in a manner where the ability to perform one task is built upon the knowledge of the former.

The student comments were assessed, resulting in a second revision of the objectives. Appendix A presents revised objectives indicating that the students will be responsible for knowing bones which will be articulated or partially articulated. The objectives state that the student should know all the names given for each anatomical part. The order of presenting the objectives of modules 11, 17, and 18 was changed as suggested by the evaluators.

Literature was reviewed in the areas of developing self-instructional materials (see Chapter II) and incorporated in the development of two modules which will serve as prototypes for the remaining series. The revised objectives were used as a criteria by which the materials of module components were selected and outlined.

The developed self-instructional modules are comprised of a printed section (Appendix C, F and I), as well as audio/visual presentation. The video-cassettes, containing part of the learning activity, and the projector slides, containing part of the post-test, are available at College of DuPage.

As suggested by Kemp (1975), Russell (1974) and other authors, the production of the self-instructional modules involved a team effort. It was found that working with the personnel who have the expertise in the various fields of the video-production design and curriculum development, proved to be a learning experience that could not be duplicated by reading about the various aspects of producing the teaching tools.

The modules were evaluated, before proceeding to produce the remaining series. An evaluation instrument, based on Hecht and Klasek (1974), was developed for checking the presence of module components suggested by Johnson and Johnson (1970) and Herrscher (1971). The instrument also rendered to receive an analysis of each component. In addition, a section was included for receiving comments relating to areas of concern as well as suggestions for improving the module series. Evaluation was performed by the module series developer, the formative evaluator and the College of DuPage Director of Instructional Design. The following table indicates the results:

TABLE 6

Checking the Presence of
Package Components
(Performed by the Faculty)

	Response	
Statement	Yes	No

Table 6 (continued)

Statement	Response Yes	No
Does the package include the following components:		
a. rationale?	3	-
b. objectives?	3	-
c. pre-assessment?	3	-
d. interactive learning activities?	3	-
e. post-test?	3	-

All evaluators concurred that all the indicated components were present in the developed modules.

TABLE 7

The Analysis of Package Components and Sequence (Performed by the Faculty)

Statement	Response Yes	No
1. Is the sequence of package components logical?	3	-
2. Does the rationale tell:		
a. what is going to be learned?	2	1
b. why this package should be studied?	3	-
3. Are the learner objectives:		
a. important for intended learners?	3	-
b. stated in terms which include an active verb identifying desired behavior?	3	-
4. Does the pre-assessment:		
a. measure learner status on each objective?	3	-
b. have clear directions for scoring?	3	-
5. Are the students directed through a clear study path?	3	-

Table 7 (continued)

Statement	Response Yes	 No
6. Do the learning activities:		
a. contribute to the achievement of package objectives?	3	-
b. include clear directions?	3	-
c. proceed in logical steps?	3	-
d. occur in steps of proper size for intended learners?	3	-
e. attract and maintain student interests?	3	-
f. require active responses by learners?	2	1
g. provide alternative learning activities for achieving each objective?	2	1
h. employ media appropriate to package objectives?	3	-
7. Does the post-test:		
a. include clear directions for completing and scoring?	3	-
b. measure learner status on each objective?	3	-
c. parallel the pre-test form, length and difficulty?	3	-
d. indicate minimum performance standards?	3	-

All evaluators felt that the sequence of the package components was logical and the rationale did indicate why this package should be studied. One member did not feel that the rationale indicated what was going to be learned.

All faculty, evaluating the modules, believed that the presented objectives were important and were stated in terms identifying desired behavior. The results indicated that the pre-assessment measured learner status on each objective and that there were clear directions for scoring. Every evaluator felt that the students were directed through a clear study path.

The evaluation results indicated that the learning activities should contribute to the achievement of the package objectives. All concurred that the learning activities include clear directions and proceed in logical steps of proper size for the intended learners. The activities employ media appropriate to package objectives and can attract and maintain student interest. One faculty member indicated that the learning activity does not provide for alternative learning, nor does it require active responses from the learners.

All faculty members indicated that the post-tests included clear directions for completing and scoring, and measured the learning status of each objective. All evaluators concurred that the post-tests were parallel to the pre-test form, length and difficulty. They agreed that the post-tests indicated the minimum performance standards.

In order to facilitate the use of modules, in order to enhance their diffusion, "Teacher's Guide to Instructional Modules: Frog Dissection and Anatomy" was developed (Appendix J). The guide contains the following topics:

a. introduction
b. module components
c. module functions
d. procedures for use
e. testing
f. student feedback

The analysis of package installation and operations is presented in the following table.

TABLE 8

The Analysis of Package Installation and Operations (Performed by the Faculty)

Statements	Response Yes	Response No
Package installation and operation		
a. Does the package include instructor's guide?		
1. suggest ways instructors can use the package with students?	3	-
2. suggest ways to help students schedule their learning time?	3	-
3. suggest ways to record and report student progress?	3	-
4. include evidence of package revision on the basis of user feedback?	2	1
5. include evidence that appropriate package users achieve package objectives?	3	-
b. Are the equipment requirements of package consistent with available audio-visual equipment?	3	-
c. Is media quality satisfactory?	3	-
d. Are package materials easy for learners to use?	3	-

The evaluators concurred that the package instructors guide suggests ways for using the modules and indicates ways to help the students to schedule their learning time. All faculty, performing the evaluation, agreed that the instructor's guide suggests ways to record and report students progress and includes evidence that appropriate package users achieve package objectives. One member did not believe that the guide includes evidence for package revision on the basis of users feedback.

All faculty involved in assessing the self-instructional package indicated that the equipment requirements of the package were consistent with available audio-visual equipment. They felt that the media quality was satisfactory and the package materials were easy for learners to use.

TABLE 9

The Analysis of the Provision
for Student Feedback
(Performed by the Faculty)

Statement	Response Yes	No
Does the package developed for the student feedback:		
a. focus on important package characteristics?	3	-
b. include objective and essay questions?	3	-

Table 9 indicates that the developed package for student feedback focuses on the important package characteristics and it does include objective as well as essay questions.

In the additional comments and suggestion section, one faculty member indicated that the learning activity is somewhat repetitive for college level students. Another evaluator felt that questions may be posed during the video presentation to assure that the students perform the activities.

An error was found in video-script of module two. The eustachian tube equalizes the pressure in the middle ear, not the inner ear. It was suggested it be said that the eustachian tube equalizes the pressure on both sides of the tympanic membrane.

Realizing the value of student input regarding the effectiveness of the self-instructional modules, a pilot-test was performed using six biology student volunteers who had not studied the frog before. The following tables show the comparisons of the pre-test and post-test scores for the two modules:

TABLE 10

Comparison of Pre-Test and Post-Test Scores
for Each of the Students Involved in
the Pilot Test of
Module 1
(Based on 100 Percent Performance)

Student	Pre-Test	Post-Test	Difference
A	50	100	50
B	42	100	58
C	22	100	78
D	22	90	68
E	80	100	20
F	14	100	86
			Average gain=60

The comparison of the pre-test and the post-test scores of Module 1 shows that learning can take place while using the self-instructional modules. The suggested performance standard for the post-test was 90 percent. All students passed the post-test with a score of 90 percent or above during the first attempt. The average gain was 60.

TABLE 11

Comparison of Pre-Test and Post-Test Scores
For Each of the Students Involved in
the Pilot Test of
Module 2
(Based on 100 Percent Performance)

Student	Pre-Test	Post-Test	Difference

Table 11 (continued)

Student	Pre-Test	Post-Test	Difference
A	44	100	56
B	31	80	49
C	26	95	69
D	0	95	95
E	0	83	83
F	12	90	78
			Average gain=72

The comparison of the pre-test and the post-test scores of Module 2 shows that learning did take place while the students were using the module. The suggested performance standard for the post-test was 90 percent. All students passed the post-test with a score of 80 percent or above during the first attempt. The average gain was 72.

An evaluation instrument was developed for student feedback (Appendix L). It involved an analysis of module components and solicited views as to whether the modules could help the students in learning frog dissection and anatomy in a stimulating and a desirable way. The questions dealing with student opinions of the learning experience were based largely on Roueche, Washburn and Mink (1974). There was also a section seeking written comments and suggestions for the improvement of the module series. The Table 12 indicates the results involving rating of topics. The scale used was as follows:

1-Strongly Disagree 2-Disagree 3-Tend to Disagree 4-Tend Agree 5-Agree 6-Strongly Agree

TABLE 12

Module Evaluation Results
(Performed by the Students)

Table 12 (continued)

Statement	Number of Students for Each Rating						
Scale:	1	2	3	4	5	6	Mean
The rationale for the study of the frog was clearly stated.					3	3	5.5
The objectives of the module series were clearly stated.				1	2	3	5.3
The pre-tests were appropriate for each section.				1	2	3	5.3
The materials presented in the learning unit were related to the objectives.					2	4	5.7
The materials presented in the learning unit were logical and sequential.					3	3	5.5
The instructions were clear and easy to follow.				1	1	4	5.5
The visual materials and diagrams were appropriate.					3	3	5.5
The learning activity was helpful in meeting the objectives.				1	1	4	5.5
I was able to receive repeated directions.					2	4	5.7
I was able to meet the objectives at a self-paced rate.				1		5	5.7
I was provided sufficient feedback informing me of the degree of achieving the intended objectives.					3	3	5.5
The post-tests were fair and related to the objectives.					4	2	5.3
I liked the way the modules were organized.				1	3	2	5.2

Table 12 (continued)

Statement	Number of Students for Each Rating						
Scale:	1	2	3	4	5	6	Mean
I really got involved in the learning activity.				2	2	2	5.0
I would recommend the module series to my friends.				1	2	3	5.3
Only with the help of the instructor was I able to meet the presented objectives.	4		2				1.7

Individual results as well as the mean scores indicated that the students agreed that the modules had a clear rationale for the study of the units, the objectives were clearly stated and the pre-tests were appropriate for each section.

The students concurred that the materials presented in the learning unit were related to the objectives and the presentation was logical and sequential. The evaluators indicated that the instructions were clear and easy to follow, the visual materials and diagrams were appropriate, and the learning activity was helpful in meeting the objectives. All students agreed that they were able to receive repeated directions, meet the objectives at self-paced rate, and that they were provided with a sufficient feedback informing them of the degree of achieving the intended objectives. The students indicated that the post-tests were fair and related to the objectives.

The results show that the students were involved in the learning activity and they liked the way the modules were organized. They all agreed that they would recommend the module series to their friends.

The students, involved in the pilot-test, felt that they could meet the presented objectives without the help of the instructor.

In the written comments section, the students indicated that what they liked best about the modules was the clearness of the objectives and the freedom to work at their own pace. One student especially liked the video-cassette presentation and the fact that the directions could be repeated through the replay. Two students stressed the value of clear step by step guidance through the learning process.

In the section where the students were asked to tell what they liked least about the modules, the following were the major comments:

a. The learning activity may be too repetitive for some students. The video-cassette presentation was reiterated in the readings of the suggested references and then again repeated in the written section of the learning activity. The evaluators felt that the repetition slowed the pace of learning and thus may bore the stronger student.

b. The physical location of the post-test, behind the learning activity having the answers, presented a temptation to cheat on the test.

The students indicated that in module two, questions three, there was no space provided for a response. They noted that the fifth projector slide of Module 1 post-test, did not provide the answer to the question.

Several students suggested taking out the post-test question requiring to identify the bulging eye, because all people should recognize an eye and this question wastes time. It was also suggested not to require the students to read the references and view the videocassette presentation. Instead, the students should be given a choice of referring to one reference or both.

This chapter presented an account of forming objectives for the frog dissection and anatomy unit, as well as the complete development of the two prototype modules. The chapter also indicated the results of the evaluations of the module components. Chapter 5 will present the summary, conclusions and recommendations based on this study.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The preceding chapter dealt with the findings of the Major Applied Research Project dealing with the development of frog dissection and anatomy self-instructional modules. This chapter sets forth the summary, conclusion, recommendations, strategies for diffusion and implementation.

Summary

The first chapter indicated that many College of DuPage students experience difficulty with the frog dissection and anatomy unit. Even though the students come from different backgrounds, with varied abilities and with different learning styles, the instruction is conducted in a traditional, time-bound manner using a lecture discussion method. There is no opportunity for self-paced learning and most references are in a printed form. The video presentations that are available have been found to be quite incomplete and thus, are seldom used. The objectives of the units are not always clear in the students minds. If a class is missed, make-up work is often difficult. The students have little opportunity to obtain repeated instruction or to check their success and note their mistakes for possible correction. Testing is done for the purpose of obtaining a grade evaluation.

Given the nature of the problem, the following questions were asked: a) What are the objectives of the frog dissection and anatomy unit? b) In order to teach the unit, what strategy can be used, and how the teaching aids be developed and presented to the heterogeneous student body? c) What evaluation method can be employed to determine the effectiveness of the modules in helping students master the objectives of the unit? d) How should an evaluation instrument be developed to receive input for improvement of the formed teaching aids? The purpose of the Major Applied Research Project was to find a solution to these research questions.

First, an extensive literature search was conducted to gain insight in: a) designing of the objectives; b) developing self-instructional materials; c) designing pre-assessment and post-assessment; d) audio-visual instruction design and presentation; e) development of evaluation instrument; and, f) methods of diffusion of the finished product.

Existing printed materials and visual aids, dealing with frog dissection, were examined for content, modes of presenting subject matter and for possible references. Self-instructional modules of related fields were studied in order to learn more about the treatment of module components.

The objectives were formed, validated and evaluated for the entire unit dealing with frog dissection and anatomy. The complete development of two prototype modules followed the protocol presented in Chapter II, page 36, incorporated the characteristics of effective self-instructional packages and their components outlined in Chapter IV, page 55-56.

As suggested by the literature search, a team was used in consulting and producing the modules. It was comprised of the author, College of DuPage Learning Resource Center Material Production personnel and the Director of Instructional Design Office, who guided and coordinated the development of the modules.

A biology faculty member, who acted as the formative evaluator was a great value in insuring that a) the product objectives be consistent with the purpose and the rationale of the instructional unit; b) the objectives covered wide enough scope for the given course; c) the objectives were clear, specific and measurable, and d) there were no mistakes in the subject content of the modules.

Evaluation instruments were designed to receive input from faculty (Appendix K) and students (Appendix L).

Module evaluation results of Table 6, performed by the faculty, revealed that all package components, suggested by Johnson and Johnson (1970) and Herrscher (1971), were present and their sequence was logical. The results of analysis of the package components indicated that the constituents of the modules met the criteria suggested by Hecht and Klasek (1974).

One faculty member felt that the rationale does not tell what is to be learned. The rationale indicated that the frog will be studied, but the details were not provided because of the extensiveness of the topic. Further elaboration of the content is presented in the table of contents in the introductory section of the module series.

In Table 7, the former evaluator indicated that the learning activity does not require active responses from the learners. However, as shown in the video script (Appendix E and H), the video-cassettes guide mainly through the dissection of the frog and aid in finding the indicated anatomical parts. The students are asked to look for the required organs together with the presentor and perform the dissection as shown in the video-cassette. The written section of the learning activity requires student involvement in answering the related questions.

Table 7 indicated that one evaluator did not believe that the developed modules offered means for alternative learning. Indeed, the students were asked to view the audio-visual presentation, they were encouraged to read about the subject content, as well as to perform a written task on the same unit. The modules do not provide a clear alternative for reaching the objectives. The formative evaluator found a mistake in the text of the video-cassette presentation which should be corrected.

The two modules were pilot-tested by six student volunteers representing the future target population. The post-test scores of Table 10 and 11 showed high gain over the pre-test. There was no control group to compare the results of modular instruction and the conventional classroom teaching method, because the intent was to find out if learning can take place using these modules and not which method was more effective.

Once the modules were pilot-tested the same students were asked to perform an evaluation of the modules. The questionnaire (Appendix L) was designed to receive input on module content as well as to assess student opinions of the learning experience.

The evaluation results, presented in Table 12, indicated that the rationale for the study was clearly stated, the objectives were clear, the pre-tests were appropriate and the materials presented in the learning unit were related to the objectives. The students perceived the learning unit presented as being logical and sequential. They felt that the instructions were clear and easy to follow. The visual materials and diagrams were appropriate, and the learning activity was helpful in meeting the objectives. The students were able to meet the objectives at a self-paced rate. They concurred that they could receive repeated directions and they were provided sufficient feedback informing them the degree of achieving the intended objectives. They suggested that the post-tests were fair and related to the objectives. The results indicated that the students liked best the clearness of the objectives and the opportunity for self-paced learning.

Two students, just as the formative evaluator, believed that the repetition of the content in the video-cassette, the suggested readings and the written section of the learning activity slows down the learning pace and thus, may bore the stronger learner. One student indicated the temptation to look at the answers in the learning activity while performing the post-test, because the former was only a page or two away.

The students felt that they could achieve the module objectives without the presence of the instructor. They liked the way the modules were organized; they were involved in the learning activity. All students indicated that they would recommend the module series to their friends.

To facilitate the diffusion of the module series, to aid the instructors in helping the students to use the product most effectively, a "Teacher's Guide to Instructional Modules: Frog Dissection and Anatomy" was developed (Appendix J). The guide presents module components and explains the use of module test result. The guide contains a section requesting to provide feedback, using the developed questionnaire, in order to receive input for future revisions of the module series.

Table 8 indicated that the equipment requirements were consistent with the available audio-visual equipment and that the materials were easy for learners to use.

Conclusions

The purposes of the Major Applied Research Project were achieved. The objectives were formulated for the entire unit of frog dissection and anatomy. They were validated, evaluated by faculty, by the students representing the future target population.

Two self-instructional modules were completely developed, pilot-tested and evaluated. Though a few changes are in order, the positive evaluation results indicated that they can be used as prototypes for the development of the remaining series.

The designed modules enable the student to pace studying according to his ability to assimilate information. The modules provide active student involvement and immediate feedback. The clear objectives, the study path, the outlined learning activity, as well as the variety of media used in the learning process can aid the poor readers and the disorganized students. The pre-tests, the post-tests and the indicated level of expected performance provide the sign-posts, enabling the student to know where he is and where he is expected to go.

The modules can furnish the means of make-up work for students who miss group presentation. The module series can provide an alternative to the conventional, time-bound class instruction method for learning frog dissection and anatomy.

To evaluate the modules, questionnaires were developed and validated. These instruments can be used not only as means of evaluating the module series, but also as a revision tool, for they can provide continuous student and faculty input.

Recommendations

1. It is recommended that the developed objectives should be used as the criteria for selecting the materials for module components, instructional procedures and the development of tests, and to complete the remaining frog dissection and anatomy module series using the basic plan of the first two modules. However, not all students need the repetition through audio-visuals, reading and writing. Therefore, the study path should provide an alternative for reaching the objectives. It should indicate that the students may view the video-cassettes to receive guidance in dissecting and finding the anatomical parts required by the objectives. They may also use the written references for reaching the goal. Written learning activities should be performed with the aid of the video-cassettes, the printed references or both, before the post-test is attempted.

2. It is also recommended that the video-cassettes should be developed only for those modules which need the audio-visuals for reaching the objectives most effectively. For example, the blood vessels are often obscured by muscles and body organs. Consequently, a student would need guidance in finding them. A diagram or photograph showing already dissected results would not provide this help and a written explanation would be hard to follow for a poor reader or a person who needs to see the process before being able to trace the steps. The modules involving the study of the skeleton, however, would not require the step by step guidance. A photograph or diagram could be just as helpful to relate to a given set of bones and thus, the video-cassette need not be made. A learning activity requiring the student to color in the bones on a drawing and write out the names,

would help the students to relate and remember the required parts.

3. It is further recommended that the text correction in the video-cassette of module two should indicate that the eustachian tube equalizes the pressure on both sides of the tympanic membrane.

A space should be provided for a response to the third question in module two, before releasing the module for student use. An answer should be included for the fifth projector slide of module on post-test, and the question requiring to identify the bulging eye should be eliminated.

4. All post-tests should be placed at the end of the learning activities of the entire module series, to reduce the temptation to turn a page or two to receive a quick answer. It is suggested that the developed objectives be used as the criteria for selecting instructional content, for determining procedures and for devising tests for the self-instructional package.

5. The faculty and, in turn, the students should be acquainted with the alternative method of instruction indicating that the modules can be used either as the main means for studying the frog dissection and anatomy, or as a supplement to class instruction and/or as an enrichment source.

6. Finally, it is recommended that the questionnaire, found in Appendix K, should be added to the faculty guide in order to receive faculty input. The questionnaire of Appendix L should be included at the end of module series printed packet, to obtain an ongoing evaluation and suggestions from the students so that the developed teaching tool could be improved.

Strategies for Diffusion and Implementation

To facilitate the diffusion and implementation of the module series dealing with frog dissection and anatomy, the following recommendations are proposed:

1. Conduct a workshop for College of DuPage biology faculty in order to familiarize them with the developed module series and their possible use.

2. During the workshop, provide a preview of the module components, both the audio-video and the printed section.

3. During the workshop, use the "Teachers' Guide to Instructional Modules: Frog Dissection and Anatomy" as the basis for explaining the role of the instructor, indicating the possible avenues for module delivery, testing, and providing feedback to the author.

4. Distribute the teachers guide and the printed packet of the module series to the on-campus and off-campus part-time faculty who will not be able to attend the workshop.

Once the faculty is familiarized with the modules, they should be able to acquaint their students with the alternative method of instruction. The instructors should demonstrate the use of the audio-visual equipment, give a preview of the developed product and explain the possible reasons for its use.

Depending on the desires and needs of various students and faculty members, the modules will be used as the main means for studying the frog dissection and anatomy or as a supplement and/or as an enrichment source.

The methods used in the designing of the self-instructional modules, should be applicable to the development of similar teaching tools in other community colleges. The research findings will be diffused outside of College of DuPage with the evaluation results, and with the conclusions and recommendations, in order to acquaint other community colleges with the procedures which were used in producing the modules. The MARP will be sent to ERIC and a summary will be presented to the journal of American Biology Teacher.

BIBLIOGRAPHY

Akin, Marion C. and Arlene Fink. "Evaluation Within the Context of Product Development: A User Orientation," in Gary D. Borich (Editor) Evaluating Educational Programs and Products, Englewood Cliffs, New Jersey: Educational Technology Publications, 1974.

Allen, William H. Intellectual Abilities and Instructional Media Design. Standford, California: ERIC Clearing House on Information Resources, 1974.

Andrews, Ted F. "A Description of Two Learning Modules," The Context of Biological Education: The Case for Change, No. 34 (August, 1972), pp. 90-93.

Babski, Carl A. "Developing and Testing a Pilot Module Program for Physical Science," ERIC ED137 073 (1976).

Baker, Gail L. and Isadore Golberg. "The Individual Learning System: What It Is and How To Use It," Educational Leadership, Vol. 27 (May, 1970), pp. 775-780.

Baker, R. L. and R. E. Schutz. Instructional Product Development. New York, New York: Van Nostrand Reinhold, 1971.

Bloom, Benjamin S. "Learning For Mastery," in John E. Roueche and Barton R. Herrscher, Toward Instructional Accountability. Palo Alto, California: Westinghouse Learning Press, 1973.

________. Taxonomy of Educational Objectives, Handbook I: Cognitive Domain. New York: David McKay Co., 1956.

________, Thomas J. Hastings and George F. Madaus. Handbook of Formative and Summative Evaluation of Student Learning. New York: McGraw-Hill Inc., 1971.

Bolvin, John O. "Implication of the Individualization of Instruction for Curriculum and Instructional Design, "Audiovisual Instruction," Vol. 13 (March, 1968), pp. 238-242.

Boston, Robert E. How to Write and Use Performance Objectives to Individualize Instruction; How to Classify a Performance Objective. Englewood Cliffs, New Jersey: Educational Technology Publications, Vol. 3, 1972a.

________. How to Write and Use Performance Objectives to Individualize Instruction; How to Develop Performance Instructional Activities and Evaluations. Englewood Cliffs, New Jersey: Educational Technology Publications, Vol. 4, 1972b.

Boyd, James W. Study Guide for Faculty Workshop Utilizing the Plato System in Classroom Instruction. Glen Ellyn, Illinois: Instructional Design Office Alternative Learning Unit, 1978.

Briggs, Leslie J., Peggie L. Campeau, Robert M. Gagne and Mark A. May. Instructional Media: A Procedure for the Design of Multi-Media Instruction, A Critical Review of Research, and Suggestions for Future Research. Pittsburgh, Pennsylvania: American Institute for Research, 1967.

Brunner, Jerome S. Toward a Theory of Instruction. Cambridge, Massachusetts: Howard University Press, 1966.

Burns, Richard W. "Methods for Individualizing Instruction," Educational Technology, Vol. 11 (June, 1971), pp. 55-56.

Campbell, Donald T. and Julian C. Stanley. Experimental and Quasi-experimental Design for Research. Chicago, Illinois: Rand McNally College Publishing Co., 1966.

Carroll, John A. "A Model of School Learning," Teachers College Record, Vol. 64 (1973), pp. 723-33.

Cavert, Edward C. An Approach to the Design of Mediated Instruction. Washington, D. C.: The Association for Educational Communications and Technology, 1974.

Coger, Rick. Developing Effective Instructional Systems. North Quincy, Massachusetts: The Christopher Publishing House, 1975.

Cohen, Arthur M. Objectives for College Courses. Beverly Hills, California: Glencoe Press, 1970.

Creager, Joan G. "Mortar for the Bricks on Humanizing the Modular Approach," in Joan G. Creager and Darrel L. Murray (Editors) The Use of Modules in College Biology Teaching. Washington, D. C.: Commission On Undergraduate Education in the Biological Sciences, 1971.

________ and Darrel L. Murray. "The Advantages of Applications of Modules," in Joan G. Creager and Darrel L. Murray (Editors) The Use of Modules in College Biology Teaching. Washington, D. C.: Commission on Undergraduate Education in the Biological Sciences, 1971.

________ and Darrel L. Murray. The Use of Modules in College Biology Teaching. Washington, D. C.: Commission on Undergraduate Education in Biological Science, National Science Foundation, March, 1971.

Cross, Patricia K. "Beyond Education for All-Toward Education for Each." The College Board Review. Vol. 99 (Spring, 1976).

________. *Beyond the Open Door*. San Francisco, California: Jossey-Bass, Inc., 1974.

________. "New Roles for College Teachers," *Community College Frontiers*. Vol. 5, No. 2 (Winter, 1976) p. 8.

Dale, Edgar. *Audiovisual Methods in Teaching*. New York, New York: Holt Rinehart and Winston Publishers, 1969.

A Directory of Self-Instructional Materials Used in the Junior College. Los Angeles, California: ERIC Clearing House for Junior College Information, California University, Los Angeles School of Education, 1971.

Diamond, Robert M., Paul Eickmann, E. Felly, F. Edward, Robert Holloway, E. Vickery, Tom Rush, Ernest T. Pascarella. *Instructional Development in Higher Education*, Syracuse University: Center for Instructional Development, 1973.

________, Paul E. Eickmann, Edward F. Kelly, Robert E. Holloway, Tom Rush, E. Vickery and Ernest T. Pascarella, *Instructional Development for Individualized Learning in Higher Education*. Englewood Cliffs, New Jersey: Educational Technology Publications, 1975.

Dodge, Richard A. and Robert L. McDonald. "An Excerpt From An Audio-Tutorial Package," in Joan G. Creager and Darrel L. Murray (Editors) *The Use of Modules in College Biology Teaching*. Washington, D. C.: Commission On Undergraduate Education in the Biological Sciences, 1971.

Drumheller, Sidney J. *Handbook of Curriculum Design for Individualized Instruction: A Systems Approach*. Englewood Cliffs, New Jersey: Educational Technology Publications, 1972.

Duane, James E., ed. *Individualized Instruction-Programs and Materials*. Englewood Cliffs, New Jersey: Educational Technology Publications, 1973.

Dwyer, Francis M. *A Guide for Improving Visual Instruction*. State College, Pennsylvania: Learning Services, 1972.

Educational Films. Champaign, Illinois: Visual Aids Service - Division of University Extension, 1972-1975.

Educators Guide to Free Films. Randolph, Wisconsin: Educators Progress Service Inc., 1978.

Educators Motion Pictures. Indiana University: Audio-Visual Center, Office for Learning Resources, 1975.

Ehrle, E. B. "Avoiding the Audio-Tutorial Mistakes," *Bio Science*, Vol. 20, No. 2 (January, 1970), p. 103.

Espich, James E. and Bill Williams. Developing Programmed Instructional Materials: A Handbook for Program Writers. Belmont, California: Fearon Publishers, 1967.

Esseff, Peter J. and Mary S. Esseff. Behavioral Task Analysis. Columbia, Maryland: Educational Systems for the Future, 1976a.

________ and Mary S. Esseff. Criterion Test Items. Columbia, Maryland: Educational Systems for the Future, 1976b.

________ and Mary S. Esseff. Developing Instructional Materials. Columbia, Maryland: Educational Systems for the Future, 1976c.

________ and Mary S. Esseff. Selecting Instructional Strategies. Columbia, Maryland: Educational Systems for the Future, 1976d.

________ and Mary S. Esseff. Selecting Media and Materials. Columbia, Maryland: Educational Systems for the Future, 1976e.

________ and Mary S. Esseff. Validating Instructional Materials. Columbia, Maryland: Educational Systems for the Future, 1976f.

Field, Nicholas J. and Peter O. Ways. "Development and Evaluation of Self-Instructional Materials," Journal of Medical Education, Vol. 47, No. 10, (October, 1972), pp. 822-824.

Film Evaluation Guide. New York, New York: Educational Film Library Association (No date).

Films too Good for Words: A Directory of Nonnarrated 16mm. Films. New York, New York: R. R. Bowker Co., 1972.

"Focus on Learning" National Conference On Innovation, Diffusion, and Delivery in Education. Newport Beach, California: The League for Innovation in the Community College, March 6-8, 1978.

Folgueras, Luis E. "Nursing Education Through Multi-Sensory Approaches, Report of A Workshop," (Delta College, University Center), ERIC ED 013 652, (December, 1966).

Friesen, P. A. Designing Instruction. Santa Monica, California: Miller Publishing, 1972.

Gilbert, Stephen G. Pictoral Anatomy of the Frog. Seattle, Washington: University of Washington Press, 1968.

Glazer, Richard B. "Project BIOTECH: Use of Modules in Technician Training," American Biology Teacher, Vol. 36, No. 5 (May, 1974), pp. 292-293.

Goldschmid, Barbara and Marcel L. Goldschmid. "Modular Instruction: Principles and Application in Higher Education," Learning and Development, Vol. 3, No. 8 (April-May, 1972).

Grosman, Minna L. "The Circulatory System," in Seba H. Kalb Medical Terminology: An Individualized Approach. Sunnyvale, California: Westinghouse Learning Press, 1975.

Gropper, George L. Diagnosis and Revision in the Development of Instructional Materials. Englewood Cliffs, New Jersey: Educational Technology Publications, 1975.

Hartley, James and Ivon K. Davies. "Preinstructional Strategies: The Role of Pretests, Behavioral Objectives, Overviews and Advanced Organizers," Review of Educational Research, Vol. 46, No. 2 (Spring, 1976), pp. 239-265.

Hecht, Alfred R. and Kristine Klasek. "PAS: A Tool for Developing or Selecting Self-Instructional Materials," Audiovisual Instruction, Vol. 20, No. 4 (April, 1975), pp. 27-29.

Herrscher, Barton R. "Alternatives to the Invalid Assumption of Current Educational Practices," in John E. Roueche and Barton R. Herrscher (Editors) Toward Instructional Accountability: A Practical Guide to Educational Change. Palo Alto, California: Westinghouse Learning Corporation, 1973a.

________. "A Systemic Approach to Instruction," in John E. Roueche and Barton R. Herrscher (Editors) Toward Instructional Accountability: A Practical Guide to Educational Change. Palo Alto, California: Westinghouse Learning Corporation, 1973b.

________. Implementing Individualized Instruction. Houston, Texas: ArChem Company Publishers, 1971.

________, Dayton Y. Roberts and John E. Roueche. Curriculum Development. Fort Lauderdale, Florida: NOVA University Press, 1973c.

Hunter, Madeline. "A Tri-Dimentional Approach to Individualization," Educational Digest. September, 1977.

Index to 16mm. Educational Films (NICEM). Los Angeles, California: National Information Center for Educational Media, 1977.

Index to 35mm. Educational Filmstrips (NICEM). Los Angeles, California: National Information Center for Educational Media, 1977.

Index to Educational Overhead Transparencies (NICEM). Los Angeles, California: National Information Center for Educational Media, 1977.

Index to Educational Slides (NICEM). Los Angeles, California: National Information Center for Educational Media, 1977.

Index to Educational Video Tapes (NICEM). Los Angeles, California: National Information Center for Educational Media, 1977.

Index to 8mm. Motion Cartridges (NICEM). Los Angeles, California: National Information Center for Educational Media, 1977.

Isaac, Stephen and William B. Michael. *Handbook in Research and Evaluation*. San Diego, California: Edits Publishers, 1976.

Jenkins, J. R. and James D. Russell. "Involving Students in Individualized Instruction," *American Biology Teacher*, Vol. 33, No. 8 (November, 1971), pp. 489-492.

Johnson, Rita B. and Stuart R. Johnson. *Assuring Learning with Self-Instructional Packages or Up the Up Staircase*. Chapel Hill, North Carolina: Self Instructional Packages Inc., 1971.

________ and Stuart R. Johnson. *Toward Individualized Learning: A Developer's Guide to Self-Instruction*. Menlo Park, California: Addison-Wesley Pub. Co., 1975.

Johnson, Stuart R. and Rita B. Johnson. *Developing Individualized Instructional Materials. A Self-Instructional Material in Itself*. Palo Alto, California: Westinghouse Learning Press, 1970.

Keller, Fred S. "Good-bye Teacher." *Journal of Applied Behavioral Analysis*. Vol. 1 (1968), pp. 79-89.

Kemp, Jerrold E. *Instructional Design: A Plan for Unit and Course Development*. Belmont, California: Fearon Publishers, 1971.

________. *Planning and Producing Audiovisual Materials*. San Francisco, California: Chandler Publishing Co., 1963.

________. *Planning and Producing Audiovisual Materials*. New York, New York: Thomas X. Cromwell Co. Inc., 1975.

Kinder, James S. *Using Audio-Visual Materials in Education*. New York, New York: American Books Co., 1975.

Klasek, B. Charles. *Instructional Media in the Modern Schools*. Lincoln, Nebraska: Professional Educators Publications, Inc., 1972.

Knowles, Malcolm S. *Self Directed Learning: A Guide for Learners and Teachers*. New York, New York: Association Press, 1975.

Krueger, Elizabeth A. "Oral Medication - Study Guide and Workbook," *A Lippincott Learning System*. Philadelphia, Pennsylvania: J. B. Lippincott Co., 1972a.

________. "Oral Medication - Teachers Guide," *A Lippincott Learning System*. Philadelphia, Pennsylvania: J. B. Lippincott Co., 1972b.

Kulik, James A., Chen Lin Kulik and Kevin Carmichael. "The Keller Plan in Science Teaching." *Science*, Vol. 183 (1974), pp. 379-383.

Kurtz, Edwin B. "Excerpts From Biology - An Individualized Approach" in Joan G. Creager and Darrel L. Murray (Editors) *The Use of Modules in College Biology Teaching*, Washington, D. C.: Commission on Undergraduate Education in the Biological Sciences, 1971.

Lange, Crystal M. "Auto-Tutorial and Mobile-Tutorial Laboratory Techniques in Nursing Education," *ERIC* ED 014 960, (March, 1966).

Lawson, Tom E. *Formative Instructional Product Evaluation: Instrument and Strategies*. Englewood Cliffs, New Jersey: Educational Technology Publications, 1974.

Learning Directory. New York, New York: Westinghouse Learning Corporation, Vol. 1-7, 1970-73.

Lewis, James, Jr. *Administering the Individualized Instruction Program.* West Nyack, New York: Parker Publishing Company, Inc., 1971.

Linder, Harris J. and Melton E. Golmon. "Teaching General Zoology -- Strategies with Multimedia," *Journal of College Science Teaching*, Vol. 5, No. 5 (May, 1976), pp. 303-306.

Mager, Robert F. *Developing Attitude Toward Learning*. Palo Alto, California: Fearon Publishers, 1968.

________. *Preparing Instructional Objectives*. Palo Alto, California: Fearon Publishers, Inc., 1963.

Mayo, G. Douglas. *Innovation and Improvement in Instruction.* Memphis State University, Tenn.: J. B. Brister Library, Monograph Series No. 4, 1976.

McKinley, Charles. "A Minicourse in Exoskeleton and Endoskeleton," in Joan G. Creager and Darrel L. Murray (Editors) *The Use of Modules in College Biology Teaching*. Washington, D. C.: Commission On Undergraduate Education in Biological Science, 1971.

McNeil, John D. "Antidote to a School Scandal," in John E. Roueche and Barton R. Herrscher (Editors) *Toward Instructional Accountability: A Practical Guide to Educational Change*. Palo Alto, California: Westinghouse Learning Corporation, 1973.

________. *Designing Curriculum, Self-Instructional Modules*. Boston, Massachusetts: Little, Brown and Co., 1976.

Mercier, Cletus R. "Use of Audio-Visual Cassette Tapes and Instructional Modules in Teaching Graphics," *ERIC* ED 123 053, (June, 1975).

Moore, William J. and Hugh F. McKeegan. "Instructional Design: After Behavioral Objectives What?" *Educational Technology*, (September 1969), pp. 45-48.

Murray, Darrel L. "BIOS i Kits: Modular Material Designed to Assist

Students in Investigation," American Biology Teacher, Vol. 38, No. 1 (January, 1976), pp. 43-47.

________. "The Components of a Module" in Joan G. Creager and Darrel L. Murray (Editors) The Use of Modules in College Biology Teaching, Washington, D. C.: Commission On Undergraduate Education in the Biological Sciences, 1971.

Musgrave, Ray G. Individualized Instruction: Teaching Strategies Focusing on the Learner. Boston, Massachusetts: Allyn and Bacon, Inc., 1975.

Nelson, Frank. Evaluation for Instructional Development. National Special Media Institute. Produced under a grant for the U. S. Office of Education, Bureau of Libraries and Educational Technology, Division of Educational Technology, Media Specialist Program, 1972.

Postlethwait, S. N. "The Audio-Tutorial System," American Biology Teacher, Vol. 32, No. 1 (January, 1970), pp. 31-33.

________. "Time for Minicourses?" The Library College Journal, Vol. 2 (Winter, 1969), pp. 24-29.

________, J. Novak and H. T. Murray. The Audio-Tutorial Approach to Learning. Minneapolis, Minnesota: Burges Publishing Co., 1972.

________, J. Novak and T. T. Murray Jr. The Audio-Tutorial Approach to Learning. Minneapolis, Minnesota: Burges Publishing Co., 1969.

Prentice, Ernest D., William K. Metcalf, Thomas H. Quinn, John G. Sharp, Richard H. Jensen and Edward A. Holyoke. "Steroscopic Anatomy: Evaluation of a New Teaching System in Human Gross Anatomy." Journal of Medical Education. Vol. 52, No. 9 (September, 1977), pp. 758-63.

Programmed Learning: A Bibliography of Programs and Presentation Devices. Bay City, Michigan: Carl H. Hendershot (No date).

Roueche, John E. and Barton R. Herrscher. Toward Instructional Accountability: A Practical Guide To Educational Change. Palo Alto, California: Westinghouse Learning Press, 1973.

________, Barton R. Herrscher and George A. Baker. Time as the Variable, Achievement as the Constant: Competancy-Based Instruction in the Community College. Washington, D. C.: AACJC, 1976. (ERIC Document No. ED122-872).

________ and John C. Pitman. A Modest Proposal: Students Can Learn. San Francisco: Jossey-Bass Publishers, 1972.

________ and Jerry J. Snow. Overcoming Learning Problems. San Francisco, California: Jossey-Bass Publishers, 1977.

_______, Barbara P. Washburn and Oscar G. Mink. Assessing Student Opinions Of The Learning Experience: An Instrument Packet. Manchaca, Texas: Sterling Swift Publishing Co., 1976.

Russell, James D. Modular Instruction: A Guide to the Design, Selection, Utilization and Evaluation of Modular Materials. Minneapolis, Minnesota: Burges Publishing Company, 1974.

Scriven, M. "The Methodology of Evaluation," In Perspectives of Curriculum Evaluation, AERA Monograph #1, Edited by R. Tyler, R. Gagne and M. Scriven, Chicago, Illinois: Rand McNally, 1967.

Skinner, B. F. "The Science of Learning and the Art of Teaching," Harvard Educational Review, Vol. 24 (1954), pp. 86-97.

_______. The Technology of Teaching. New York, New York: Appleton Century Crofts, 1968.

Sorenson, Garth. "A New Role in Education: The Evaluator," in John E. Roueche and Barton R. Herrscher (Editors) Toward Instructional Accountability: A Practical Guide to Educational Change. Palo Alto, California: Westinghouse Learning Corporation, 1973.

Thornton, John W. "Modules and Investigative Laboratories" in Joan G. Creager and Darrel L. Murray (Editors) The Use of Modules in College Biology Teaching, Washington, D. C.: Commission On Undergraduate Education In the Biological Sciences, 1971.

_______. "An Example of a Module Using Programmed Format," in Joan G. Creager and Darrel L. Murray (Editors) The Use of Modules in College Biology Teaching, Washington, D. C.: Commission On Undergraduate Education In the Biological Sciences, 1971.

Thornwald, Esbensen. Working with Individualized Instruction. Belmont, California: Fearon Publishers, 1968.

Tyler, Ralph W. Basic Principles of Curriculum and Instruction. Chicago, Illinois: The University of Chicago Press, 1970.

Underhill, Raymond A. Laboratory Anatomy of the Frog. Dubuque, Iowa: W.M.C. Brown Company Publishers, 1975.

Vasiliauskas, Jura. Instructional Module: Frog Dissection and Anatomy, A Practicum Presented to Nova University in Partial Fulfillment of the Requirements for the Degree of Doctor in Education, Fort Lauderdale, Florida: Nova University, March 27, 1978.

Von Blum, Ruth. "Individualizing Instruction in Large Undergraduate Biology Laboratories: I. Development of a Model," American Biology Teacher, Vol. 37, No. 8 (November 1975), pp. 467-469.

Walker, Warrner F., Jr. Laboratory Studies in Biology - Dissection of the Frog. San Francisco, California: W. H. Freeman and Company, 1967.

Washburn, Barbara P. Implementing Personalized Instruction: A Systemic Approach. A Self-Instructional Workbook. Dubuque, Iowa: Kendall/Hunter Publishing Co., 1975.

Wells, T.A.G. The Frog: A Practical Guide. New York, New York: Dover Publications Inc., 1964.

Withers, John D. "Identification of Formed Elements in Human Blood," in Joan G. Creager and Darrel L. Murray (Editors) The Use of Modules in College Biology Teaching. Washington, D. C.: Commission On Undergraduate Education in Biological Sciences, 1971.

Wolf, W. C., Jr. "Utilizing Effective Diffusion Strategies," ERIC ED 102 671, (April, 1975).

APPENDIX A

Objectives of the Module Series

MODULE 1

EXTERNAL ANATOMY

OBJECTIVES

After completing this module, you should be able to:

1. List three characteristics which indicate that the frog is still tied to the acquatic environment.

2. Give three (3) functions of the skin.

3. Explain the effect of melanin, yellow pigment and the crystals of guanine upon the skin pigmentation of the frog.

4. Explain the advantage of the broken color pattern of the skin.

5. Name and identify the following external features:
   a. external nares
   b. bulging eyes
   c. upper lid
   d. lower lid
   e. nictitating membrane
   f. tympanic membrane
   g. cloacal aperture

6. Describe the function of:
   a. nictitating membrane
   b. tympanic membrane
   c. cloacal aperture

7. Explain the advantage of the elevated, bulging eyes.

MODULE 2

THE MOUTH PARTS

OBJECTIVES

After completing this module, you should be able to:

1. Name and identify the following mouth parts:
    - a. maxillary teeth
    - b. vomerine teeth
    - c. internal nares
    - d. eustachian tube
    - e. esophagus
    - f. glottis and laryngotrachael chamber
    - g. openings to the vocal sac (in males only)
    - h. tongue

2. Describe the function of:
    - a. maxillary teeth
    - b. vomerine teeth
    - c. internal nares
    - d. eustachian tubes
    - e. esophagus
    - f. glottis
    - g. openings to the vocal sac (in males only)
    - h. tongue

3. Name another term for buccal cavity

MODULE 3

GENERAL TERMINOLOGY

RATIONALE

There are numerous terms used in the studying of the anatomy to indicate the position of the various organs. Unfortunately, some of the terms are used differently when referring to the human body than when referring to other animals.

By knowing the terminology, you will find it easier to relate to and find the needed parts when studying the frog or the human anatomy.

OBJECTIVES

After completion of the module, you should be able to:

1. Define and differentiate the following terms in conjunction with the frog as well as with the human, specifying the body planes:
    a. coronal (frontal)
    b. median
    c. transverse
    d. sagittal

2. Define and differentiate the following terms in conjunction with the frog as well as with the human body specifying the directions and positions:
    a. anterior
    b. cranial (cephalic)
    c. caudal
    d. distal
    e. dorsal
    f. inferior
    g. medial
    h. lateral
    i. proximal
    j. posterior
    k. superior
    l. ventral

3. Give the term which, in invertebrates, means horizontal longitudinal section (parallel to the dorsal and ventral surfaces.)

4. Explain why the term cranial is not appropriate to use in conjunction with the invertebrates.

MODULE 4

INTRODUCTION TO THE MAJOR BODY SYSTEMS

OBJECTIVES

After completing the module, you should be able to:

1. Define the term organ and give at least three (3) examples.
2. Define the term system.
3. Name eleven major body systems.
4. Name the major constituents of each system.
5. Give at least one function for each system.
6. Explain why an organ may be part of several body systems.

MODULE 5

THE SKELETON, GENERAL INFORMATION

OBJECTIVES

After completing the module, you should be able to:

1. Give three major functions of the skeleton.
2. Name the major areas comprising the axial skeleton.
3. Name the major areas comprising the appendicular skeleton.
4. Name and identify the following areas.
    a. skull
    b. vertebral column
    c. sternum
    d. pectoral girdle
    e. pelvic girdle

MODULE 6

THE AXIAL SKELETON - THE SKULL
(DORSAL VIEW)

OBJECTIVES

After completion of the module, you should be able to:

1. Name and identify the following bones:
    a. premaxilla
    b. maxilla
    c. quadratojugal
    d. nasal
    e. sphenethmoid
    f. frontoparietal
    g. pterygoid
    h. squamosal
    i. prootic
    j. exoccipital

Note: You will perform the above tasks on an entirely articulated skeleton or on a portion of a skeleton having several jointed bones.

2. Define the terms:
    a. condyle
    b. foramen

3. Name and find:
    a. occipital condyle
    b. foramen magnum

MODULE 7

THE AXIAL SKELETON - THE SKULL (VENTRAL VIEW)

OBJECTIVES

After the completion of the module, you should be able to:

1. Name and identify the following bones:
    - a. premaxilla
    - b. maxilla
    - c. quadratojugal
    - d. vomer
    - e. palatine
    - f. parasphenoid
    - g. sphenethmoid
    - h. prootic
    - i. pterygoid
    - j. columella
2. Tell what go will go through the foramen magnum.
3. Name and identify the following bones of the lower jaw (mandible):
    - a. Mento-Meckelian
    - b. dentary
    - c. angulosplenial
4. Name and identify the hyoid apparatus and tell its location.

Note: You will perform the above tasks on an entirely articulated skeleton or on a portion of a skeleton having several jointed bones.

MODULE 8

THE VERTEBRAL COLUMN AND THE PELVIC GIRDLE

OBJECTIVES

At the completion of the module, you should be able to:

1. Name and identify the following bones:
   - a. atlas
   - b. unmodified vertebrae
   - c. sacral vertebrae
   - d. urostyle
2. Name and identify:
   - a. transverse process
   - b. spinous process
   - c. centrum
   - d. neural canal
3. Name the bones of the pelvic girdle
4. Name and identify:
   - a. ilium
   - b. ischium
   - c. pubis
5. Name and identify acetabulum
6. Name the bone that articulates with acetabulum

Note: You will perform the above tasks on an entirely articulated skeleton or on a portion of a skeleton having several jointed bones.

MODULE 9

THE PECTORAL GIRDLE

OBJECTIVES

At the completion of this unit, you should be able to:

1. Name the bones of the pectoral girdle

2. Name and identify:
    a. sternum
    b. coracoids
    c. clavicles
    d. scapulae
    e. suprascapulae

3. Name and identify glenoid cavities

4. Tell which bones articulate the glenoid cavity.

Note: You will perform the above tasks on an entirely articulated skeleton or on a portion of a skeleton having several jointed bones.

MODULE 10

THE BONES OF THE FORE LIMB AND THE HIND LIMB

OBJECTIVES

At the completion of this module, you should be able to name and identify the following bones of the:

1. Fore limb
    - a. humerus
    - b. radioulna
    - c. carpals
    - d. metacarpals
    - e. phalanges
2. Hind limb
    - a. femur
    - b. tibiofibula
    - c. proximal tarsals
        - (1) calcaneus
        - (2) astragalus
    - d. prehallux
    - e. metatarsals
    - f. phalanges

Note: You will perform the above tasks on an entirely articulated skeleton or on a portion of a skeleton having several jointed bones.

MODULE 11

MUSCLE DISSECTION AND THE ASSOCIATED TERMINOLOGY

OBJECTIVES

At the completion of this module, you should be able to:

1. Remove the frog's skin without injuring the muscles
2. Give at least 3 functions of the skin
3. Show the major subcutaneous lymph sacs
4. Define the following terms:
    a. fascia
    b. septa
5. Name the three muscle types
6. Give the major characteristics of each muscle type
7. Define the following terms:
    a. muscle origin
    b. muscle insertion
    c. flex
    d. extend
    e. protract
    f. retract
    g. adduct
    h. abduct
    i. pronate
    j. supinate
8. Expose individual muscles for identification.

MODULE 12

THE MUSCULAR SYSTEM - THE MUSCLES OF THE HIND LIMB (DORSAL VIEW)

OBJECTIVES

At the completion of this module, you should be able to:

1. Expose, name and identify the following muscles of the thigh (dorsal view):
    a. illiacus externus (gluteus)
    b. iliacus internus
    c. triceps femoris
        (1) rectus anticus femoris (tensor fasciae latae)
        (2) vastus externus (gluteus magnus)
        (3) vastus internus (cruralis)
    d. iliofibularis
    e. semimembranosus
    f. gracilis minor
    g. piriformis

2. Expose, name and identify the following muscles of the shank (dorsal view):
    a. tibialis anticus longus
    b. peroneus
    c. gastrocnemius (plantaris longus)

Note: If there is more than one name for a given muscle, you should be able to use both names.

MODULE 13

THE MUSCULAR SYSTEM - THE MUSCLES OF THE HIND LIMB (VENTRAL VIEW)

OBJECTIVES

At the completion of this module, you should be able to:

1. Expose, name and identify the following muscles of the thigh (ventral view):
   a. vastus internus (cruralis) of triceps femoris
   b. adductor longus
   c. sartorius
   d. adductor magnus
   e. gracilis major
   f. gracilis minor
2. Expose, name and identify the following muscles of the shank (ventral view):
   a. gastrocnemius (plantaris longus)
   b. tibialis posticus
   c. extensor cruris brevis
   d. tibialis anticus brevis
   e. tibialis anticus longus
3. Name and identify the tendon of Achilles

Note: If there is more than one name for a given muscle, you should be able to use both names.

MODULE 14

THE MUSCULAR SYSTEM - THE MUSCLES OF THE HEAD AND TRUNK (DORSAL VIEW)

OBJECTIVES

At the completion of this module, you should be able to:

1. Expose, name and identify the following muscles of the head (dorsal view):
   a. pterygoid
   b. temporalis
   c. masseter
   d. depressor mandibulae

2. You are able to expose, name and identify the following dorsal trunk muscles:
   a. depressor mandibulae
   b. dorsalis scapulae
   c. latissimus dorsi
   d. rhomboideus
   e. longissimus dorsi
   f. iliolumbaris
   g. coccygeoiliacus
   h. cutaneous abdominis
   i. iliacus externus
   j. external oblique
   k. anal sphincter

MODULE 15

THE MUSCULAR SYSTEM - THE MUSCLES OF THE HEAD AND THE TRUNK (VENTRAL VIEW)

OBJECTIVES

At the completion of this module, you should be able to expose, name and identify the following:

1. Ventral head muscles:
   a. submaxillary (mylohyoid)
   b. submental
   c. medial geniohyoid
   d. lateral geniohyoid
2. Ventral trunk muscles:
   a. pectoralis (3 parts)
   b. coracoradialis
   c. cutaneous pectoris
   d. rectus abdominis
   e. internal oblique

Note: If there is more than one name for a given muscle, you shall be able to use both names.

MODULE 16

THE MUSCULAR SYSTEM - THE MUSCLES OF THE SHOULDER AND THE FORELIMB

OBJECTIVES

At the completion of this module, you should be able to expose, name and identify the following muscles:

1. Ventral view:
   a. deltoid
   b. palmaris longus
   c. flexor carpi radialis
   d. flexor carpi ulnaris

2. Dorsal view:
   a. anconeus
   b. extensor digitorum communis longus

MODULE 17

FROG DISSECTION, BODY CAVITIES AND THE ASSOCIATED STRUCTURES

OBJECTIVES

After completing the module, you should be able to:

1. Dissect the frog correctly and expose the internal body organs.

2. Name the three germ layers
   a. ectoderm
   b. mesoderm
   c. endoderm

3. Define the following terms:
   a. coelom
   b. viscera

4. Define the term peritoneum and give the name of the embryonic tissue layer from which it originated.

5. Name and identify the following:
   a. parietal peritoneum
   b. visceral peritoneum

6. Identify and give the function of mesenteries

7. Locate and/or name the following body cavities:
   a. pericardial cavity
   b. pleuroperitoneal cavity

MODULE 18

THE DIGESTIVE SYSTEM

OBJECTIVES

After completing the module, you should be able to:

1. Name, identify and tell the function of the following:
   a. buccal (oral cavity)
   b. tongue
   c. vomerine teeth
   d. maxillary teeth
   e. pharynx
   f. esophagus
   g. stomach
   h. pyloric sphincter
   i. small intestine
      (1) duodenum
      (2) jejunoileum
   j. large intestine (colon)
   k. cloaca
   l. cloacal aperture
   m. liver
   n. gall bladder
   o. pancreas

2. You can name one or more secretion of the liver and the pancreas (associated with digestion) and give the function.

3. You can name the area of the digestive tract to which the above secretions will be taken.

4. You can name a function of the liver and pancreas which is not associated directly with digestion.

Note: If there is more than one name for a given area, you should know both names.

MODULE 19

THE RESPIRATORY SYSTEM

OBJECTIVES

After completing the module, you should be able to:

1. Name the organs that are involved in the gas exchange between the frog and the environment.
2. Name and identify the following:
   a. glottis
   b. larngotracheal chamber
   c. lungs
3. Explain the embryological relationship between the digestive and the respiratory systems.

MODULE 20

THE EXCRETORY SYSTEM

OBJECTIVES

After completing the module, you should be able to:

1. Name, identify and give the function of the following:
    - a. kidneys
    - b. Wolffian duct (mesonephric ducts)
    - c. bladder
    - d. cloacal aperture
2. Name two other body organs associated with excretion of the body wastes.

Note: If there is more than one name for a given area, you should know both names.

MODULE 21

THE MALE REPRODUCTIVE SYSTEM

OBJECTIVES

After completing the module, you should be able to:

1. Name, identify and give the function of the following:
    a. testes
    b. mesorchium
    c. vas efferens (pl. vasa efferentia)
    d. Wolffian ducts
    e. seminal vesicles
    f. cloacal aperture
    g. fat body
2. Trace the path of sperm transfer from the testes to the cloacal aperture.

MODULE 22

THE FEMALE REPRODUCTIVE SYSTEM

OBJECTIVES

After completing the module, you should be able to:

1. Name, identify and give the function of the following:
   a. ovary
   b. mesovarium
   c. ostium
   d. oviducts
   e. ovisacs ("uterus") location
   f. cloacal aperture
   g. fat body

2. Give at least two functions of the oviduct.

3. Trace the path of the egg transfer from the ovary to the cloacal aperture.

MODULE 23

THE CIRCULATORY SYSTEM - INTRODUCTION

OBJECTIVES

After completing the module, you should be able to:

1. Name and identify the:
   a. paricardial sac
   b. the heart
      (1) the auricles
      (2) the ventricle

2. Give at least five functions of the circulatory system

3. Define:
   a. artery
   b. vein
   c. capillary

4. Tell which blood vessels are high in oxygen and which blood vessels are low in oxygen.

MODULE 24

THE CIRCULATORY SYSTEM
THE MAJOR ARTERIES OF THE UPPER THIRD OF THE BODY

OBJECTIVES

After completing the module, you should be able to:

1. Expose and name the following arteries:
    a. conus arteriosus
    b. truncus arteriosus
        (1) carotid artery
            (a) external carotid
            (b) internal carotid (and the carotid gland)
    c. systemic arch
        (1) occipito-vertebral
        (2) subclavian
            (a) brachial
            (b) musculocutaneous
    d. pulmocutaneous artery
        (1) pulmonary
        (2) cutaneous

2. Indicate the path of blood flow from and to each of the arteries above.

MODULE 25

THE CIRCULATORY SYSTEM
THE MAJOR ARTERIES OF THE LOWER TWO-THIRDS OF THE BODY

OBJECTIVES

After completing the module, you should be able to:

1. Expose and name the following arteries:
    a. dorsal aorta
        (1) coeliacomesenteric
            (a) coeliac
                1. gastric
                2. hepatic
            (b) anterior mesenteric
                1. splenic
                2. intestinal
        (2) urogenital
        (3) gonadal (Note: In males the gonadal is called testicular and in the females, it is called the ovarian.)
        (4) posterior mesenteric
    b. common iliac
        (1) hypogastric
        (2) femoral
        (3) sciatic
2. Indicate the path of blood flow from and to each of the arteries above.

MODULE 26

THE CIRCULATORY SYSTEM
THE MAJOR VEINS OF THE UPPER THIRD OF THE BODY

OBJECTIVES

After completing the module, you should be able to:

1. Expose and name sinus venosus
2. Expose and name the following veins:
    a. anterior vena cava
        (1) external juglar
        (2) innominate
            (a) internal juglar
            (b) subsapular
        (3) subclavian
            (a) brachial
            (b) musculocutaneous
    b. posterior vena cava
3. Indicate the path of blood flow from and to each of the veins above.

MODULE 27

THE CIRCULATORY SYSTEM
THE MAJOR VEINS OF THE VISCERAL REGION

OBJECTIVES

After completing the module, you should be able to:

1. Expose and name the following veins:
    a. posterior vena cava
        (1) hepatic
        (2) renal
    b. hepatic portal
        (1) gastric
        (2) splenic
        (3) other abdominal visceral veins associated with the corresponding organs
    c. dorsolumbar
    d. gonadal (spermatic, ovarian)
2. Indicate the path of blood flow from and to each of the veins above.

MODULE 28

THE CIRCULATORY SYSTEM
THE MAJOR VEINS OF THE POSTERIOR BODY REGION

OBJECTIVES

After completing the module, you should be able to:

1. Expose and name the following veins:
    a. sciatic
    b. femoral
    c. external iliac
    d. renal portal
    e. pelvic
    f. ventral abdominal
2. Indicate the path of blood flow from and to each of the veins above.

MODULE 29

THE CIRCULATORY SYSTEM
THE PATH OF BLOOD FLOW THROUGH AND OUT OF THE HEART

OBJECTIVES

After completing the module, you should be able to:

1. Trace the blood flow through the heart.
2. Indicate the areas of high and low oxygen blood in the heart.
3. Trace the blood flow out of the heart.

MODULE 30

THE NERVOUS SYSTEM
(PART I)

OBJECTIVES

After completing the module, you should be able to:

1. Define
    a. meninges
    b. dura mater
    c. pia mater

2. Name the two main divisions of the nervous system

3. Name the two main divisions of the central nervous system

4. Name the two main subdivisions of the peripheral nervous system

5. Give the function of
    a. somatic nervous system
    b. autonomic nervous system

6. Name the two main subdivisions of the autonomic nervous system

7. Give the function of:
    a. sympathetic nerves
    b. parasympathetic nerves

MODULE 31

THE NERVOUS SYSTEM
(PART II)

OBJECTIVES

After completing the module, you should be able to:

1. Expose as well as take out the brain and the spinal cord correctly.
2. Name and identify the following parts:
    a. olfactory nerves
    b. olfactory bulbs
    c. cerebral hemisphere
    d. third ventricle
    e. thalamus
    f. optic lobes
    g. cerebellum
    h. fourth ventricle
    i. medulla oblongata
    j. optic chiasma
    k. optic tract
    l. hypothalamus
    m. pituitary gland
3. Give one function for each part above.
4. Give the function of the cerebrospinal fluid.
5. Give the function of choroid plexuses.

APPENDIX B

Evaluation Form of the Objectives

Evaluation Form of the Objectives

Instructional Modules: Frog Dissection and Anatomy

To the Student:

The development of an effective learning modules is a long and often painstaking process. Your help is needed to make the evaluation of objectives in order to find out the areas of weakness and thus, make the needed improvements.

I. Circle your perception of the following statements using the indicated code:

	strongly agree	agree	tend to agree	tend to disagree	disagree	strongly disagree
	1	2	3	4	5	6
A. By reading the objectives, I know what I am expected to do in the unit						
Circle ...	1	2	3	4	5	6
B. The objectives tell me what I should be able to do at the successful completion of an assignment.						
Circle ...	1	2	3	4	5	6

II. Please rate the pair of items by circling the number which comes closest to describing how you feel about the objectives of each module. The objectives of the module are:

	Extremely	Moderately	Median	Moderately	Extremely	
Specific...	1	2	3	4	5	... General
Numerous...	1	2	3	4	5	... Few
Measurable.	1	2	3	4	5	... Non-measurable

III. Please list the objectives that:

A. Do not indicate clearly what you are expected to do for the prescribed task.

B. Do not tell you what you should be able to do at the successful completion of the prescribed task.

APPENDIX C

Introduction to Instructional Modules: Frog Dissection and Anatomy

Instructional Modules

Frog Dissection and Anatomy

by Jura Vasiliauskas

Prepared under the direction of the Instructional Design Office
James W. Boyd, Director
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Preface

The developed instructional modules, dealing with frog dissection and anatomy, employ a variety of techniques to aid you in learning the required materials. Video-cassettes were developed for most sections, in order to provide you with the opportunity to study the frog by audio-visual means. Diagrams as well as printed references were also given, in order to meet the needs of the varied learning styles.

The instructor package consists of 31 modules. It is believed that it is easier to reach the final goal of knowing the technique of frog dissection and knowing the anatomical parts, if you *master small units of objectives at a time.*

Each module has:

1. A **Pre-Test** which will give you the opportunity to make an assessment of what you know. It will indicate the areas of weakness which you should aim to eliminate during the learning activity.
2. **Objectives** which will indicate what you should know at the end of the learning activity.
3. A **Study Path** which will indicate the sequence that you should follow in reaching your goal of mastering the module.
4. A **Post-Test** which will indicate how well you have mastered the given task and the areas which still need improvement.

Please note: The post-test, like the other specified activities, will aid you to prepare for the formal laboratory test to be given by your instructor. To be fair to yourself, *take the post-test without looking at the answers beforehand.*

There are six cumulative tests:

Test 1 deals with the external anatomy and the mouth parts
Test 2 deals with the frog skeleton
Test 3 deals with the frog muscles
Test 4 deals with the internal body organs
Test 5 deals with the circulatory system
Test 6 deals with the nervous system

It is hoped that by the time you finish the modules and take the cumulative tests, you can take the formal laboratory tests with confidence. *The formal laboratory tests will be given by your instructor and they will determine your grade.*

Remember, you can achieve mastery of the subject if you devote enough time for learning. The biology instructor will give you extra help whenever you find that there is a need.

Please Read All

of the following pages which will explain the *organization*, the *rationale*, the *needed materials* and the *procedures* to be followed while studying the frog anatomy and dissection using the self-paced modular method.

You will find that by knowing why are you going through a prescribed task, what study aids you need and how to achieve the mastery of the subject, your learning process will be easier.

Rationale for The Study of The Frog

You will be studying the frog because frogs can be easily obtained and dissected, and *they show the major features of the organ systems characteristic of the backboned animals, or the vertebrates, like man.*

It is hoped that the experience and the knowledge gained during the presented learning activities will aid you, later, in the study and understanding of the human anatomy.

Caution and Advice

Through the audio-visual presentation, printed drawings and figures will aid you in learning the structures and body organs of the frog, they should not serve as a substitute for careful dissection and observation. You will find that working with your own specimen, seeing and feeling the organs, will give you a very different perception. It will give you a learning experience that cannot be duplicated by being "just an observer."

Know what you are doing before you cut. All dissection should be performed carefully and neatly. When you study the deeper structures, push the overlapping organs to the side and cut out as few parts as possible. Be especially cautious not to destroy the major blood vessels.

Read and follow all directions developed to aid you in learning the unit.

Equipment and Materials

A. Frog (will be provided by the school)
B. Dissecting kit
C. Dissecting tray and pins (will be provided)
D. Audio-visual equipment (as indicated in the modules)
E. A study guide which will be used in conjunction with the module series:

Walker, Warrner, F., Jr. Laboratory Studies in Biology-Dissection of the Frog. San Francisco, California: W.H. Freeman and Company, 1967.

If you desire to look at additional references, the recommended guides are:

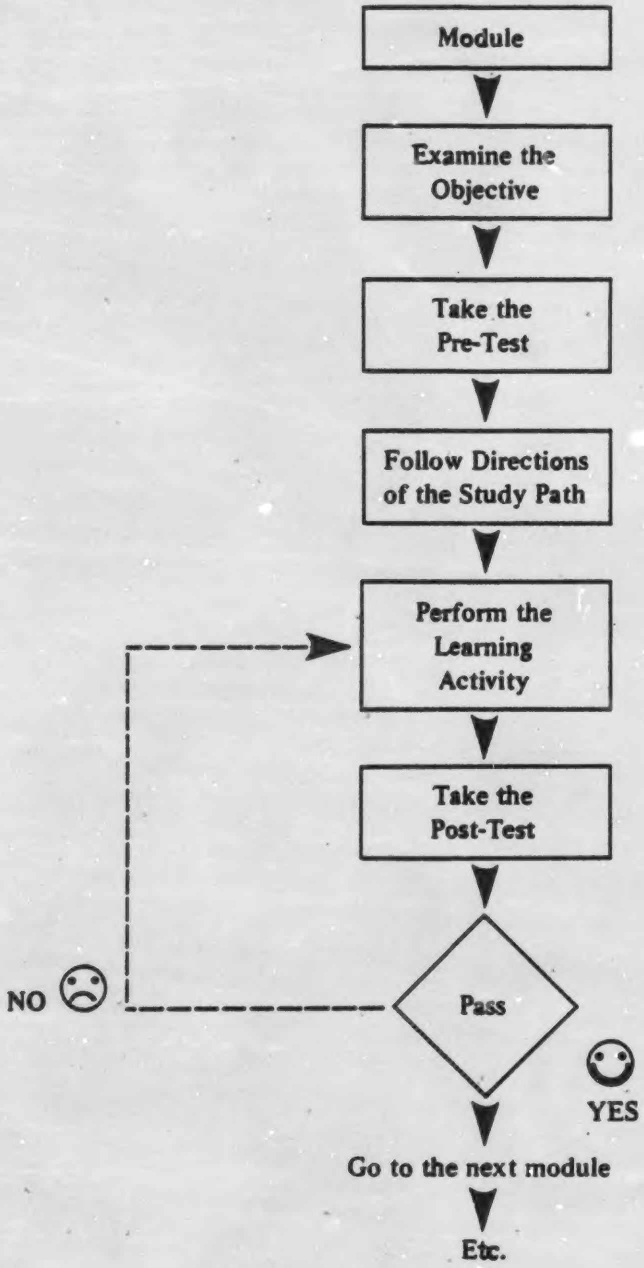
Gilbert, Stephen G. Pictoral Anatomy of the Frog. Seattle, Washington: University of Washington Press, 1968.

Underhilld, Raymond A. Laboratory Anatomy of the Frog. Dubuque, Iowa: W.M.C. Brown Company Publishers, 1976.

Wells, T.A.G. The Frog—A Practical Guide. New York, New York: Dover Publications, Inc., 1964.

Directions

I. Follow the steps indicated below in the pursuit of learning frog dissection and anatomy:


Module
Examine the Objective
Take the Pre-Test
Follow Directions of the Study Path
Perform the Learning Activity
Take the Post-Test
Pass
NO
YES
Go to the next module
Etc.

(The given level of performance is set)

II. Take the cumulative tests when it is indicated. These tests will provide you with a clue as to whether you are ready to take your class examination and obtain satisfactory results.

APPENDIX D

Instructions to the Production Staff (Module One)

INSTRUCTIONS TO THE PRODUCTION STAFF

MODULE 1

I. Presentation of Learning Activity

   A. Video on the instructor during the

      1. introduction

      2. rationale

      3. discussion of the aquatic and terrestrial attributes

      4. other areas as indicated in the script

   B. Video on the frog

      during the presentation of all the objectives as indicated in the script.

II. Post-Test

   A. Slides for Objective #5

      1. Two sets of slides will be required showing each anatomical site.

         a. Slides with test question numbers and arrows indicating the anatomical points, without proving the answer.

         b. Slides with test question numbers and answers (the names of the anatomical parts are indicated in Objective #5).

   B. One slide with the word STOP.

   C. No video will be required for written questions of objectives 1, 2, 3, 4, 6 and 7.

APPENDIX E

Script for Module One Video-Cassette Presentation

MODULE 1

VIDEO:	TREATMENT:	AUDIO:
fade up		
medium close up Jura in lab set		Most biology students study the frog because frog specimens are easily obtained and the frog has all the major features of the organ systems characteristic
start slow zoom		of the vertebrates. Hopefully, the knowledge and experience you gain through the following learning activities and materials will aid you later on in studying and understanding human anatomy.
end slow zoom at head and shoulders		Before we begin Module 1, I would like to offer a few words of advice. Although the videocassettes, study guide and other printed materials provided will help you to learn the structures and body organs of the frog, they are no substitute for careful dissection and firsthand observation. You will find

Script 1 Page 1

MODULE 1

VIDEO:	TREATMENT:	AUDIO:
		that working with your own specimen, seeing and feeling the organs themselves, will provide you with a very different perception. It is a learning experience that cannot be matched by your being just an observer. So please read the study guide carefully and follow the directions it contains. In that way, your study of the frog will be very rewarding.
slow zoom out to reveal worktable area in front of Jura with frog specimens		Let's begin our study by observing some of the most obvious characteristics of the frog.
		Pick up your frog and examine it. Because the frog is an amphibian, it has a mixture of aquatic and terrestial characteristics.

MODULE 1

VIDEO:	TREATMENT:	AUDIO:
cut to medium close up Jura handling frog		Notice that the frog has no distinct neck. The lack of neck and shoulders enables the frog to swim without creating resistance which would slow down the movement of the frog through the water. If you stretch out the body from the sides, like this, the silhouette of the frog resembles that of a fish. Notice the webbed feet. They enable the frog to push himself through the water.
cut to encyclovideo footage		Now what are the terrestial characteristics? Well, frogs can live outside of water since the adults do not depend on gills for breathing; they have lungs. They can jump and they can feed on land. The transition from water to land, however, is not complete. The frog must return to water or moist areas to

MODULE 1

VIDEO:	TREATMENT:	AUDIO:
		spawn, that is, to lay eggs, for their eggs have no protective shell and they would easily dehydrate on land. The larval form of the frog, the tadpole, has gills and must live in water.
cut to Jura at work table		Now let's look closely at the external features of the frog. As I point them out, try to find each part on your own frog.
cut to close up of frog	CAMERA FOLLOWS ACTION	First, use your probe, like this, to point to the
lower third super	external nares	external nares, the openings of the nostrils. You should know that the nares close when the frog is submerged so that water does not come in and fill the lungs.
lower third super	bulging eyes	Now notice the bulging eyes. What are the advantages of having elevated eyes? If you remember that the frog

VIDEO:	TREATMENT:	AUDIO:
		has no distinct neck and therefore cannot turn its head, you can understand why the eyes are so large and protruding. The elevated eyes provide a broad field of vision.
lower third super	upper lid	Now find the upper lid of the eye. . .
lower third super	lower lid	and the lower lid. (PAUSE)
lower third super	nictitating membrane	Next, look for a thin, transparent extension of the lower eyelid. This is the nictitating membrane. It is capable of extending across the eyeball and offers protection to the eye. It also moistens and cleanses the eye.
lower third super	tympanic membrane	Now look for a disc-shaped area behind each eye. This is the eardrum or tympanic membrane. In the female frog, it is about the size of the eye. In the male frog, it is considerably larger than the eye.

MODULE 1

VIDEO:

TREATMENT:

AUDIO:

This is not the case in all species of frog. In the bullfrog, however, it is definitely a feature of sexual dimorphism, that is, a structural difference attributable to the sex of the frog. Examine the frogs of your classmates, looking for this size difference of the tympanic membrane, or tympanum, as it is cometimes called.

It may be interesting to note that there is another difference between the male and the female which is more pronounced during the mating season. During the mating season, the foreleg thumb of the male develops a pad to aid in embracing the female.

cut to
Jura at worktable

The female's thumb has no paid. Incidentally, the thumb of the frog is comparable to a second

MODULE 1

VIDEO:	TREATMENT:	AUDIO:
		finger. As you study the bones of the frog, you will find a vestige of a fifth finger located closest to the body.
cut to close up of frog handled by Jura		Now let's examine the frog's skin. First of all,
lower third super	protects internal structures	it is protective. Have you ever felt a live frog?
lower third super	supplements the lungs	The skin is moist. It is used to supplement the lungs in gas exchange. The frog may gain water through the skin when it is in an aquatic environment; on the other hand, it may lose considerable amounts of water when it is on land.
		Have you noticed the varied color pattern of the skin? The greenish color of the frog's back enables it to
lower third super	camouflages the animal	blend in with the color of the land or the surface of the water. The irregular blotchy pattern obscures

VIDEO:	TREATMENT:	AUDIO:
		the shape of the frog. The light belly, with its rippled coloration, also serves to obscure the body features of the frog when it is viewed in the water from below.
lower third super	cloacal aperture	Now, viewing the frog from the top, like this, look for the cloacal aperture at the junction of the hind legs. When you find it, stick your probe into the aperture. Through the cloacal aperture wastes are eliminated and eggs or sperm are released.
cut to medium close up Jura at worktable		We have looked at the external features of the frog. let's go over them briefly one more time.
cut to close up of frog		First, we located the external nares. Did you find

MODULE 1

VIDEO:	TREATMENT:	AUDIO:
handled by Jura		them on your frog? Next, we looked at the bulging eyes; and the upper and lower lids. We located the nictitating membrane. Can you recall its function? Then we moved back to find the tympanic membrane. We looked at the skin of the frog and described its functions. Finally, we located the cloacal aperture.
cut to medium shot of Jura in lab set		Now turn off the videocassette and perform the learning activity indicated in your study guide.
fade to black		

APPENDIX F

Module One

Study Guide

MODULE 1

External Anatomy

Module 1 Objectives

After completing this module, you should be able to:

1. List three characteristics which indicate that the frog is still tied to the aquatic environment.
2. Give three (3) functions of the skin.
3. Explain the effect of melainin, yellow pigment and the crystals of guanine upon the skin pigmentation of the frog.
4. Explain the advantage of the broken color pattern of the skin.
5. Name and identify the following external features:
   a. external nares
   b. bulging eyes
   c. upper lid
   d. lower lid
   e. nictitating membrane
   f. tympanic membrane
   g. cloacal aperture
6. Describe the function(s) of:
   a. nictitating membrane
   b. tympanic membrane
   c. cloacal aperture
7. Explain the advantage of the elevated, bulging eyes.

Module 1 Pre-Test

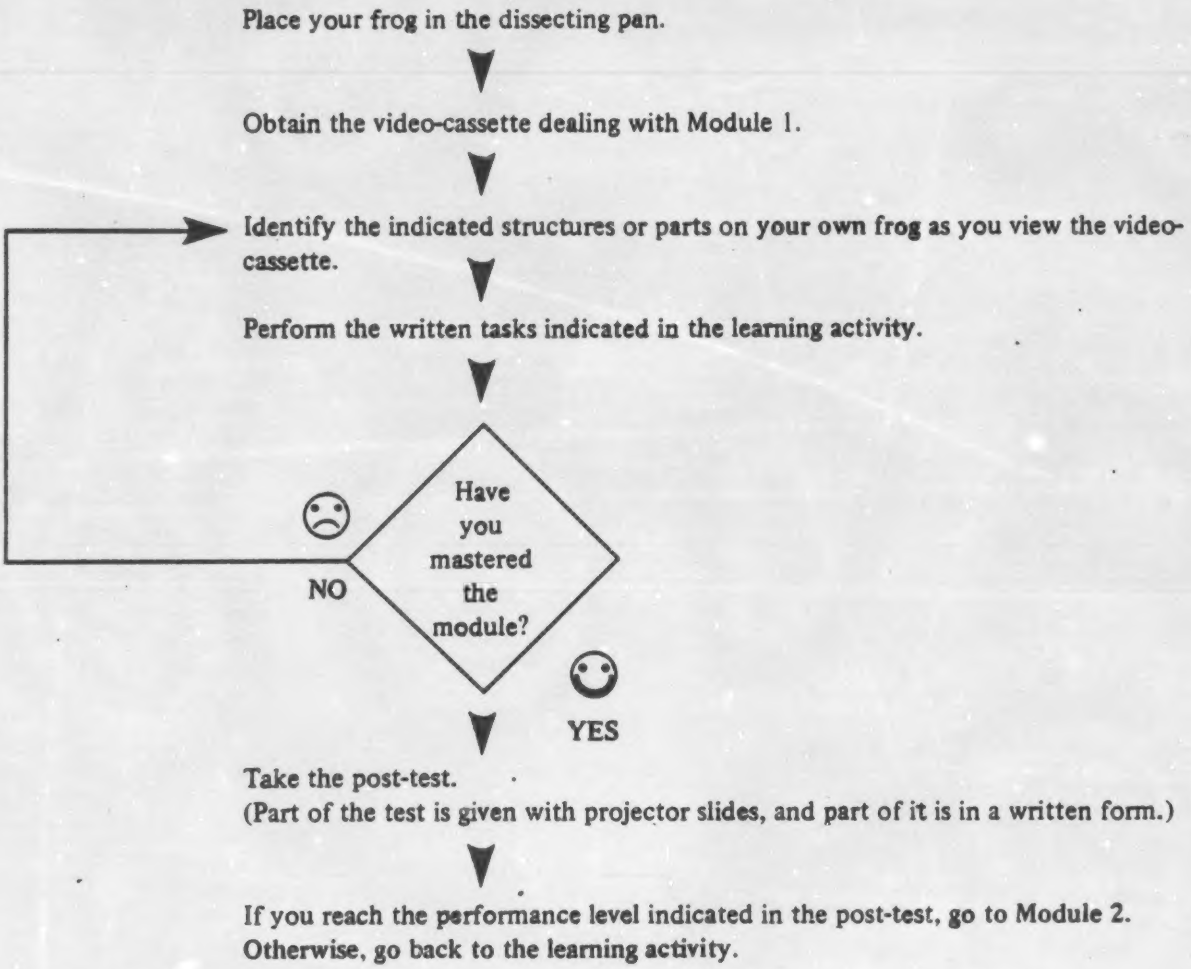
In the answer column, indicate with a check whether you feel that you *can* or *cannot* perform the indicated task *with confidence.*

ANSWER		TASK
Yes	No	
___	___	1. You can list three (3) characteristics which indicate that the frog is still tied to the aquatic environment.
___	___	2. You can list three (3) functions of skin.
___	___	3. You can explain in writing the effect of melanin, yellow pigment and the crystals of guanine upon the skin pigmentation of the frog.
___	___	4. You can explain in writing the advantages of the broken color pattern of the frog's skin.
		5. You can identify the following:
___	___	a. external nares
___	___	b. eyes
___	___	c. upper lid
___	___	d. lower lid
___	___	e. nictitating membrane
___	___	f. tympanic membrane
___	___	g. cloacal aperture
		6. You can explain in writing the function of:
___	___	a. nictitating membrane
___	___	b. tympanic membrane
___	___	c. cloacal aperture
___	___	7. You can explain in writing the advantage of the elevated, bulging eyes.

Note the areas of weakness which you should aim to eliminate during the learning activity.

Module 1

Study Path



Place your frog in the dissecting pan.

Obtain the video-cassette dealing with Module 1.

Identify the indicated structures or parts on your own frog as you view the video-cassette.

Perform the written tasks indicated in the learning activity.

Take the post-test.
(Part of the test is given with projector slides, and part of it is in a written form.)

If you reach the performance level indicated in the post-test, go to Module 2.
Otherwise, go back to the learning activity.

Module 1 Learning Activity

(You should have your frog in the dissecting pan.)

I. While watching the video presentation, complete the following activities:

A. Identify the following external features:

1. external nares
2. bulging eyes
3. upper lid
4. lower lid
5. nictitating membrane
6. tympanic membrane
7. cloacal aperture

B. Match the following by placing a number by the appropriate definition of a term:

1. external nares
2. nictitating membrane
3. tympanic membrane
4. cloacal aperture

___ A common passage way for the products of the reproductive, digestive and urinary systems

___ Openings of the nasal cavity

___ Thin, transparent tissue hinged at the lower lid of the eye. It protects, cleanses and moistens the eye

___ The eardrum

C. Explain in writing the advantage of the elevated, bulging eyes.

Continued

Module 1 Learning Activity

II. After watching the video presentation, complete the following activities:

A. Write out the seven external features of learning activity 1-A. Identify the parts again and place a check after each structure that you remember with confidence. (If you feel that you are not sure of yourself, you may want to view the videocassette again.)

1. ____________________
2. ____________________
3. ____________________
4. ____________________
5. ____________________
6. ____________________
7. ____________________

B. List three characteristics which indicate that the frog is still tied to the aquatic environment.

1. ____________________
2. ____________________
3. ____________________

(To check your answers, refer to Laboratory Studies in Biology by Walker, No. 770, pg. 1-2)

C. List three functions of the skin: (To obtain your answers, refer to Walker No. 770, pg. 2)

1. ____________________
2. ____________________
3. ____________________

Continued

D. Explain in writing, the effect of melanin, yellow pigment and the crystals of guanine upon the skin pigmentation of the frog. (To obtain your answers refer to Walker No. 770, pg. 2 and 4)

E. Explain, in writing, the advantages of the broken color pattern of the frog's skin. (To obtain your answers, refer to Walker, No. 770, pg. 4)

Module 1 Post-Test

The test will consist of two parts:

A. Questions presented on the projector slides.
B. Written questions.

Directions

1. Place your own frog in a dissecting pan.
2. Obtain the projector slide post-test for Module 1.
3. Set up the slide projector with the slides.

Module 1 Test Questions

Points Possible **A. Projector Slides**

(7) View the projector slides and write the names of the indicated areas:

1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________
5. ______________________________
6. ______________________________
7. ______________________________

STOP!

The next seven (7) slides will provide you with the answers to the slide questions.

Place a check (√) next to each *correct* answer. Place an (X) next to a *wrong* answer.

Points Possible B. Written Test Questions

(3) 1. List three (3) functions of the skin:

a. ______________________________

b. ______________________________

c. ______________________________

Continued

Module 1 Post-Test

Points Possible

(1) 2. Explain, in writing, the advantages of the broken color pattern of the frog's skin.

(3) 3. Explain, in writing, the effect of the following on the skin pigmentation of the frog:

a. melanin ______________________________

____

b. yellow pigment ______________________________

____

c. crystals of guanine ______________________________

____

(3) 4. List three characteristics which indicate that the frog is still tied to the aquatic environment.

a. ______________________________

b. ______________________________

c. ______________________________

Continued

Points
Possible

(3) 5. Describe the function of the

a. nictitating membrane

b. tympanic membrane

c. cloacal aperture

(1) 6. Explain, in writing, the advantage of the elevated, bulging eyes.

To obtain correct answers to the written questions, refer to the notes of your learning activity.

DID YOU PASS THE TEST?

☺ Count the number of right answers (The points are indicated on the left side of each question.) If you receive 19 points out of 21 possible, you may go to the next module.

☹ If you did not accumulate 19 points, go back and study the answers to the missed questions.

Repeat the whole post-test, but not today! This way, you will get a better picture of your true retention of the subject matter.

APPENDIX G

Instructions to the Production Staff (Module Two)

INSTRUCTIONS TO THE PRODUCTION STAFF

MODULE 2

I. Materials needed prior to video-presentation

   A. Diagram of the frog's mouth parts (already produced)

II. The use of the diagram of frog's mouth parts

   A. In the learning activity (the lines should be retained but the labels should be removed).

   B. In video presentation for a "walk through" of the mouth parts.

III. Presentation of the Learning Activity

   A. Video on the instructor
      during the introduction

   B. Video on the frog

      1. showing how to cut the sides of the frog's mouth in order to open it.

      2. during the "walk through" the mouth parts in the diagram.

      3. during the "walk through" the mouth parts in the frog specimen.

   C. Use overlays naming the terms that are being discussed.

IV. Post-Test

   A. Slides for Objective #1

      1. two sets of slides will be required showing each anatomical site.

         a. slides with test question number and arrows indicating the anatomical point, without providing the answer.

         b. slides with question numbers and answers (the names of the anatomical parts are indicated in Objective #1).

B. One slide with the word STOP.

C. No video will be required for the written questions.

APPENDIX H

Script for Module Two Video-Cassette Presentation

MODULE 2

VIDEO:	TREATMENT:	AUDIO:
fade up		
medium close up Jura in lab set		In this module you will learn the parts of the frog's mouth. But, before you can study the mouth parts, you must first open the frog's tightly clamped jaws. So place your frog in the dissecting pan in front of you and watch how to open the jaws.
cut to close-up frog	jaws being opened	Take your probe and insert it in between the jaws like this. Make a small slit on one side . . . , and then on the other side. You will now find that the mouth opens with little resistance.
	displays open mouth, shows mucous, if any	You may find some mucous in the mouth. If you feel it might obstruct your view of some of the mouth parts, wash it out or clean it out with a paper towel.

MODULE 2

VIDEO:	TREATMENT	AUDIO:
cut to medium close-up of Jura in lab set		Let us pause now to look at a diagram of the frog's mouth so that you will know what to look for when you work with your frog specimen.
cut to or dissolve diagram of frog's	DIAGRAM UNDERLAYS ALL GRAPHICS	
lower third super	maxillary teeth	In the frog's mouth, you will find the maxillary teeth along the outside of the upper jaw.
lower third super	vomerine teeth	In the upper jaw, you will also look for the vomerine teeth which are centrally located
lower third super	internal nares	On either side of the vomerine teeth, you will find the internal nares.
lower third super	openings to eustachian tubes	In the back of each side of the upper jaw, you will find the openings to the eustachian tubes.
		The most prominent structure on the lower jaw

MODULE 2

VIDEO:	TREATMENT:	AUDIO:
lower third super	forked tongue	is the forked tongue. Behind the tongue, you will find a swelling with an opening referred to
lower third super	glottis	as the glottis. Behind the glottis, you will
lower third super	esophagus	find the esophagus.
		In the back of each side of the lower jaw in
lower third super	openings to vocal sacs	male frogs only, you will find the openings to vocal sacs.
fade or dissolve		
medium close up Jura in lab set		Now open up your frog's mouth, which may also be referred to as the buccal cavity, and look for the parts you saw on the diagram.
cut to close up of frog	CAMERA FOLLOW ACTION	First, feel the outer ridge of the frog's upper jaw; it is a rough ridge. These are the maxillary
lower third super	maxillary teeth	teeth which are located only on the upper jaw.

MODULE 2

VIDEO:	TREATMENT:	AUDIO:
		They are not very effective in chewing; their main function is to help the frog hold onto the prey.
lower third super	vomerine teeth	Notice, in the front of the upper jaw, the two vomerine teeth. They are slanted backwards and they also help the frog hold onto the prey. As a matter of fact, the more the prey struggles to escape, the harder a grip the vomerine teeth will exert.
lower third super	internal nares	On either side of the vomerine teeth are the internal nares. These are really the nostril openings. If you follow through with your probe, you will see that they open on the outside.
lower third super	openings to eustachian tubes	In the back of each side of the upper jaw, look for the openings to the eustachian tubes. The

VIDEO:	TREATMENT:	AUDIO:
		eustachian tubes equalize pressure within the inner ear.
lower third super	forked tongue	Now look at the forked tongue. Since these frogs are preserved, you might find the tongue stiff and inflexible. In the living frog, the tongue is very elastic. It is covered with mucous and it can be slipped out quickly by the frog to catch insects or some other prey. Now look for a swelling just behind the tongue. In the center of the swelling you will find a slit
lower third super	glottis	which is the glottis. This opening leads to the
lower third super	laryngotracheal chamber	laryngotracheal chamber which is comprised of the larynx containing the vocal cords and the tracheal tube entering the lungs.
lower third super	esophagus	Now let's find the esophagus. Insert the probe

MODULE 2

VIDEO:	TREATMENT:	AUDIO:
		behind the swelling to locate it. The esophagus leads into the stomach. The esophagus can expand to a great degree enabling the frog to swallow larger prey like a small fish or a crayfish.
lower third super	openings to vocal sacs	Now look for the openings to the vocal sacs found only in the male frog. Look for one on each side of the lower jaw. Make sure that you insert your probe into the actual opening of the vocal sac rather than into some imaginary opening that, believe me, some students are really able to make. If you don't have a male frog, find a fellow student who does and look at the openings to the vocal sacs.
cut to (voiceover) frog footage from Encyclovideo		It is interesting to note how the frog makes sounds. Both males and females have vocal chords. The vocal

MODULE 2

VIDEO:	TREATMENT:	AUDIO:
sound under narration		cords are set into vibration as the air is driven back and forth between the mouth and the lungs. Because the nares and the mouth are tightly closed when the call is being vocalized, the frog is able to make the sound even under water. The female frog makes a soft sound and many are almost mute. The male frogs are considerably louder because the vocal sacs amplify the sound. (pause for several seconds)
cut to medium shot of Jura in lab set		Now turn off the videocassette and perform the learning activity indicated in the study guide.

APPENDIX I

Module Two

Study Guide

Module 2 Objectives

After completing this module, you should be able to:

1. Identify the following mouth parts:
    a. maxillary teeth
    b. vomerine teeth
    c. internal nares
    d. eustachian tubes
    e. esophagus
    f. glottis and laryngotracheal chamber
    g. openings to the vocal sacs (in males only)
    h. tongue
2. Describe the function of:
    a. maxillary teeth
    b. vomerine teeth
    c. internal nares
    d. eustachian tubes
    e. esophagus
    f. glottis
    g. openings to the vocal sacs (in males only)
    h. tongue
3. Name another term for buccal cavity.

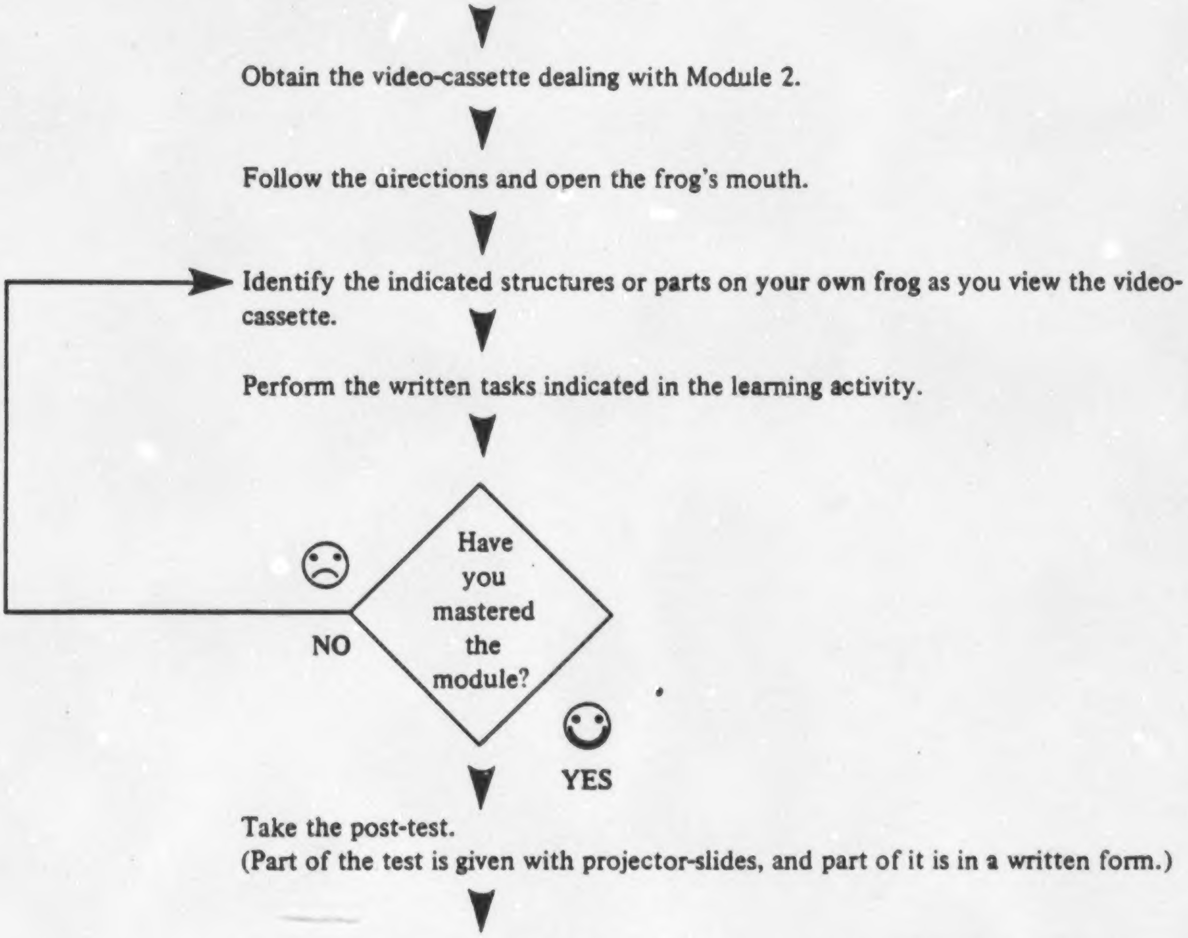
Module 2 Pre-Test

In the answer column, indicate with a check whether you feel that you *can* or *cannot* perform the indicated task *with confidence.*

ANSWER		TASK
Yes	No	1. You can name and identify the following parts of the mouth:
___	___	a. maxillary teeth
___	___	b. vomerine teeth
___	___	c. internal nares
___	___	d. eustachian tubes
___	___	e. esophagus
___	___	f. glottis and laryngotracheal chamber
___	___	g. openings to the vocal sacs (in males only)
___	___	h. tongue
		2. You can explain in writing the functions of:
___	___	a. maxillary teeth
___	___	b. vomerine teeth
___	___	c. internal nares
___	___	d. eustachian tubes
___	___	e. esophagus
___	___	f. glottis
___	___	g. openings to the vocal sacs (in males only)
___	___	h. tongue
		3. Name another term for buccal cavity.

Note the areas of weakness which you should aim to eliminate during the learning activity.

Module 2 Study Path



Place your frog in the dissecting pan.

Obtain the video-cassette dealing with Module 2.

Follow the directions and open the frog's mouth.

Identify the indicated structures or parts on your own frog as you view the video-cassette.

Perform the written tasks indicated in the learning activity.

Take the post-test.
(Part of the test is given with projector-slides, and part of it is in a written form.)

If you reach the performance level indicated in the post-test, go to Module 3. Otherwise, go back to the learning activity.

Module 2 Learning Activity

(You should have your frog in the dissecting pan, in front of you.)

I. While watching the video presentation, complete the following on your own frog specimen:

A. Name and identify the following features on your frog specimen:

1. maxillary teeth
2. vomerine teeth
3. internal nares
4. eustachian tube
5. esophagus
6. glottis and laryngotracheal chamber
7. openings to the vocal sacs
8. tongue

B. Match the following by placing a number by the appropriate definition of a term. The numbers may be used more than once.

1. maxillary teeth
2. vomerine teeth
3. internal nares
4. eustachian tube
5. esophagus
6. glottis
7. laryngotracheal chamber
8. openings to the vocal sacs
9. buccal cavity

___ Openings to the nasal cavity
___ Found only in males
___ Teeth found between the internal nares
___ A passage leading to the stomach
___ A ridge of teeth
___ Mouth cavity
___ A passage between the ear and pharynx serving to equalize the air pressure on both sides of the eardrum
___ A slit-like aperture leading to larynx
___ Does not aid in chewing but helps to hold the prey
___ A tube leading to the lungs and vocal cords

II. After watching the video presentation, complete the following activities:

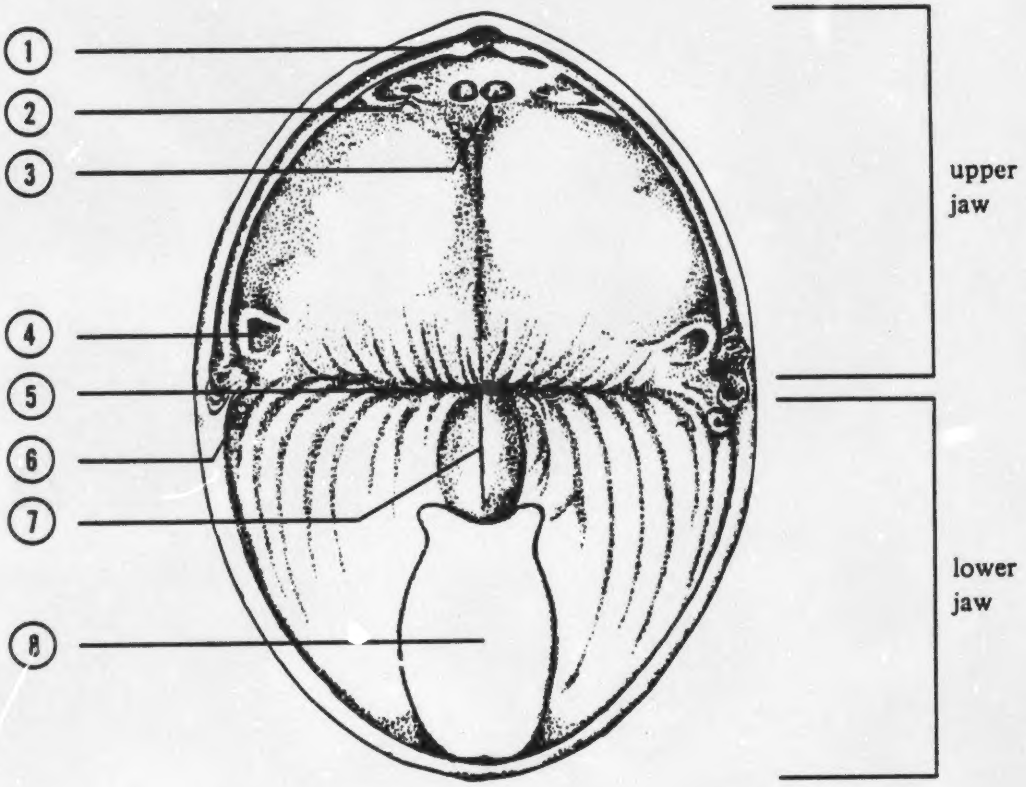
A. Label all parts, from memory, in the attached drawing. (To check your answers, refer to Walker No. 772, pg. 2)

B. Name another term for the mouth or the oral cavity:

___

Module 2 Learning Activity

THE FROG'S MOUTH


1
2
3
4
5
6
7
8
upper jaw
lower jaw

1. ______________________

2. ______________________

3. ______________________

4. ______________________

5. ______________________

6. ______________________

7. ______________________

8. ______________________

Module 2 Post-Test

The test will consist of two parts:

A. Questions presented on the projector slides.
B. Written questions.

Directions

1. Place your own frog in a dissecting pan.
2. Bring the projector slide post-test for Module 2.

Module 2 Test Questions

Points Possible **A. Projector Slides**

(8) View the projector slides and write the names of the indicated areas:

1. ______
2. ______
3. ______
4. ______
5. ______
6. ______
7. ______
8. ______

STOP!

The next eight (8) slides will provide you with the answers to the slide questions.

Place a check (√) next to each *correct* answer. Place an (X) next to a *wrong* answer.

Continued

Module 2 Post-Test

Points Possible **B. Written Test Questions**

(8) 1. Describe the functions of the following parts:

a. vomerine teeth

b. esophagus

c. tongue

d. maxillary teeth

e. eustachian tube

f. openings to the vocal sac

g. glottis

h. internal nares

(1) 2. Which sex has the openings to the vocal sac?

(1) 3. What is another term for the mouth cavity?

To obtain the correct answers to the written questions, refer to your learning activity notes.

DID YOU PASS THE TEST?

☺ Count the number of right answers. (The points are indicated on the left side of each question). **If you received 15 points out of 18 possible, you may go to the next module.**

☹ If you did not accumulate 15 points, go back and study the answers to the missed questions.

Repeat the whole post-test, but not today! This way, you will get a better picture of your true retention of the subject matter.

APPENDIX J

Teacher's Guide to Instructional Modules: Frog Dissection and Anatomy

Teacher's guide to

INSTRUCTIONAL MODULES

Frog Dissection and Anatomy

by Jura Vasiliauskas

Prepared under the direction of the Instructional Design Office
James W. Boyd, Director
College of DuPage

Introduction

The modules dealing with frog dissection and anatomy were designed for independent study to be used at the convenience of the student.

Your students probably come from different backgrounds, with varied abilities and with different learning styles. The presented modules are designed to aid the heterogenous group of students in reaching the unit objectives with success.

Module Components

A. Printed Packet comprised of:

1. Introduction containing:
    - a. Preface
    - b. Rationale for the study of the frog
    - c. Caution and advice section
    - d. Equipment and materials for the study of the modules (including the suggested text)
    - e. General directions
    - f. Table of contents indicating the general topics of the modules
2. Modules containing:
    - a. Operational objectives
    - b. Pre-test
    - c. Study path
    - d. Learning activity (used in conjunction with the video-cassettes)
    - e. Post-test (used in conjunction with the post-test slides)

B. Video-cassettes for part of the learning activity

C. Projector-slides for a part of the post-test

D. Projector-slide cumulative tests for the following areas:

1. external anatomy and mouth parts
2. skeleton
3. muscles
4. internal body organs
5. circulatory system
6. nervous system

Module Functions

A. The modules will give the students the opportunity to meet the unit objectives *with the help of audio-visuals* and *direct guidance* through the learning process.

B. The series will aid the students who are devicient in reading skills, and those who have an unusual learning style, in mastering the learning task *at their own pace.*

C. The module will provide means of *make-up work* for students who miss group presentation.

D. The modules will give the learners the opportunity to *receive repeated directions,* check success and note their mistakes, by providing the means of comparing their findings to the indicated structures in the audio/visual presentation, and/or in the given references of the learning activity.

E. The modules will furnish the students with a *means* of *evaluating progress.*

F. If the students will have gone through a series of post-tests simulating laboratory test situations, they should have more confidence during the actual testing.

G. The modules may be used either as a supplemental and enrichment source, or be used as the main means for studying the frog dissection and anatomy unit.

Procedures for Use

A. Mode of Delivery

Be sure to make adequate arrangements for the accessibility of the video-cassette players and the slide projectors. The equipment may be made available in:

a. biology laboratories
b. Developmental Learning Laboratory (DLL)
c. satelite laboratories of the extension college
d. Learning Resource Center

Receive permission from the appropriate supervisors to permit the students to bring the specimens.
Instruct the students to bring a dissecting tray, a box or some other container for placing the frog during the dissection period.
Emphasize that the area should be left clean and free of any remnants of the body parts.

B. Orientation with the Instructional Material

Before your students start using the modules:

1. **Familiarize yourself** with the program so that you can answer the student questions.

2. **Provide an orientation** for the students:
   a. Present the rationale for this method of instruction.
   b. Show the use of equipment.
   c. Explain the purpose of the pre-test and the post-test.
   d. Give the students the opportunity to manipulate and use the mechanical equipment.

C. You and Your Student During Modular Instruction

You should be alert to student needs for assistance. Be available to answer questions and provide help when it is needed or when the request is made.

Even under self-instructional format, it is suggested that there should be regularly scheduled meetings in order to monitor student progress and provide encouragement.

In order to insure steady rate of progress, it is recommended that tentative schedule be set up with your student for passing each unit.

Testing

The ***tests are not designed to give the students a grade evaluation.*** Their real purpose is to determine individual student placement, progress and to identify individual strengths and the areas that need attention.

The post-tests indicate the scoring method and the suggested level of performance before progressing to the next module.

The cumulative test should indicate to the student the level of mastery of the objectives and, hopefully, provide them confidence for the formal laboratory examination.

The *grade evaluation* should be determined by a *formal laboratory* test to be *given by the instructor.*

Student Feedback

At the completion of the module series, please ask your students to perform the questionnaire found at the end of the student module series packet. Return the evaluation form to the author.

The student feedback will provide evidence if the package users were able to achieve the given objectives as well as furnish input for future module revision.

APPENDIX K

Module Evaluation Form

(Performed by the Faculty)

MODULE EVALUATION FORM

(Performed by the Faculty)

The development of effective self-instructional modules is a long and often painstaking process. Your help is needed to make an assessment of the module components in order to find out how the developed teaching aid may serve the students in meeting the intended objectives, as well as what improvements could be made to make the modules more effective.

DIRECTIONS: Place a yes or no in the answer column. Write down your comments in the indicated space at the end of the questionnaire.

Answers (Yes or No)

A. PACKAGE COMPONENTS AND SEQUENCE

1. Does the package include the following components:
   - a. rationale? ______
   - b. objectives? ______
   - c. pre-assessment? ______
   - d. interactive learning activities? ______
   - e. post-test? ______
2. Is the sequence of package components logical? ______

B. ANALYSIS OF PACKAGE COMPONENTS

1. Does the rationale tell:
   - a. what is going to be learned? ______
   - b. why this package should be studied ______
2. Are the learner objectives:
   - a. important for intended learners? ______
   - b. stated in terms which include an active verb identifying desired behavior? ______
3. Does the pre-assessment:
   - a. measure learner status on each objective? ______
   - b. have clear directions for scoring? ______
4. Are the students directed through a clear study path? ______

5. Do the learning activities:
   a. contribute to the achievement of package objectives? ______
   b. include clear directions? ______
   c. proceed in logical steps? ______
   d. occur in steps of proper size for intended learners? ______
   e. attract and maintain student interests? ______
   f. require active responses by learners? ______
   g. provide alternative learning activity for achieving each objective? ______
   h. employ media appropriate to package objectives? ______

6. Does the post-test:
   a. include clear directions for completing and scoring? ______
   b. measure learner status on each objective? ______
   c. parallel the pre-test form, length and difficulty? ______
   d. indicate minimum performance standards? ______

7. Package installation and operation
   a. Does the package include instructor's guide? ______
      1. suggest ways instructors can use the package with students? ______
      2. suggest ways to help students schedule their learning time? ______
      3. suggest ways to record and report student progress? ______
      4. include evidence of package revision on the basis of user feedback? ______
      5. include evidence that appropriate package users achieve package objectives? ______

   b. Are the equipment requirements of the package consistent with available audio-visual equipment? ______

   c. Is media quality satisfactory? ______

   d. Are package materials easy for learners to use? ______

STOP!

Please look at the student questionnaire before answering the next two questions.

8. Does the package development student feedback:
    a. focus on important package characteristics? ________
    b. include objective and essay question? ________

C. WRITTEN COMMENTS AND SUGGESTIONS

In addition to the topics covered in the questionnaire, please give suggestions which could improve the present unit on frog dissection and anatomy.

APPENDIX L

Module Evaluation Form

(Performed by the Students)

Do not write your name on the questionnaire.

MODULE EVALUATION FORM

(Performed by the Students)

The development of effective self-instructional modules is a long and often painstaking process. Your help is needed to make an evaluation in order to find out how the modules are serving the student in meeting the intended objectives and what improvements could be made to make the modules more effective.

DIRECTIONS: Circle one number which represents your impression about each statement and include additional pertinent comments in the space provided. Read each statement carefully and use this scale for rating:

1-Strongly Disagree	2-Disagree	3-Tend to Disagree	4-Tend to Agree	5-Agree	6-Strongly Agree

1. The rationale for the study of the frog was clearly stated.

   Comments:

   -- 1 2 3 4 5 6

2. The objectives of the module series were clearly stated.

   Comments:

   -- 1 2 3 4 5 6

3. The pre-tests were appropriate for each section.

   Comments:

   -- 1 2 3 4 5 6

4. The materials presented in the learning unit were related to the objectives.

   Comments:

   -- 1 2 3 4 5 6

5. The materials presented in the learning unit were logical and sequential.

Comments:

--- 1 2 3 4 5 6

6. The instructions were clear and easy to follow.

Comments:

--- 1 2 3 4 5 6

7. The visual materials and diagrams were appropriate.

Comments:

--- 1 2 3 4 5 6

8. The learning activity was helpful in meeting the objectives.

Comments:

--- 1 2 3 4 5 6

9. I was able to receive repeated directions.

Comments:

--- 1 2 3 4 5 6

10. I was able to meet the objectives at a self-paced rate.

Comments:

--- 1 2 3 4 5 6

11. Only with the help of the instructor was I able to meet the presented objectives.

Comments:

--- 1 2 3 4 5 6

12. I was provided sufficient feedback informing me of the degree of achieving the intended objectives.

Comments:

--- 1 2 3 4 5 6

13. The post-tests were fair and related to the objectives.

Comments:

--- 1 2 3 4 5 6

14. I liked the way the modules were organized.

Comments:

--- 1 2 3 4 5 6

15. I really got involved in the learning activity.

Comments:

--- 1 2 3 4 5 6

16. I would recommend the module series to my friends.

Comments:

--- 1 2 3 4 5 6

What I liked most about the modules was:

What I liked least about the modules was:

I would improve the modules by:

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